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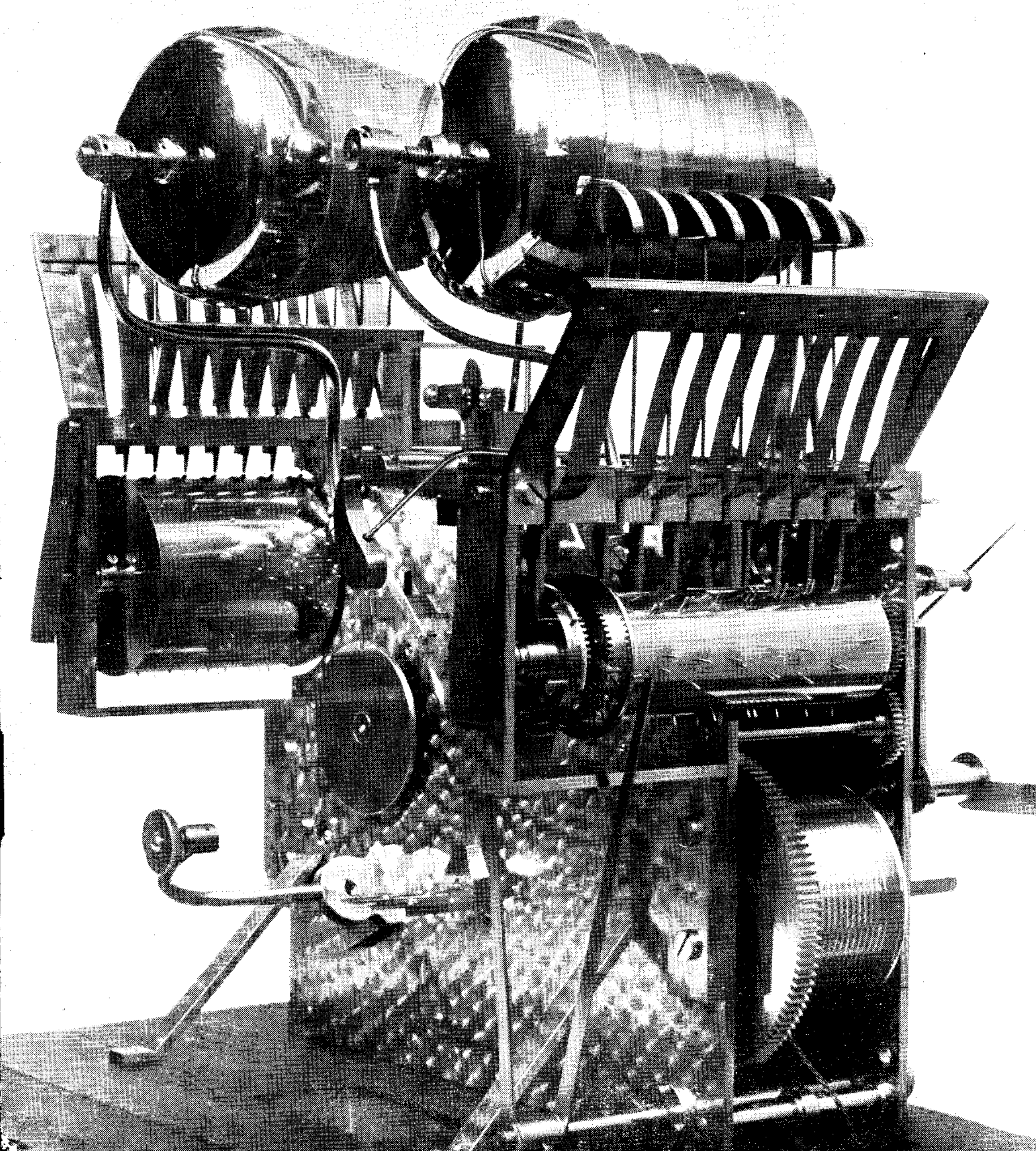
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

9TH OCTOBER 1952 VOL. 107 NO. 2681

SMOKE RINGS

Our Cover Picture

● ALL VISITORS to " M.E." Exhibitions in recent years are undoubtedly familiar with the splendid examples of horological work by Mr. A. B. Reeve, of Hastings. For several years now, he has contributed exhibits of outstanding interest with unfailing regularity, and for this year's Exhibition, he has produced one of the most intricate types of clocks, having not only striking and chiming mechanism, but also a musical movement, operating through a pin barrel on a set of ten tuned bells, with provision for several changes of tunes. The chimes comprise eight bells, with an additional bell for the hour striking gear, making nineteen bells in all. The mechanism, shown in this photograph, is weight-driven, and housed in a handsome long case of burr walnut.

In spite of the prodigious amount of work which Mr. Reeve carries out in the construction of clocks, he is never too busy to advise and assist other readers who encounter problems in horological work, not only in this country, but also as far afield as Australia, and we have received several testimonials from readers, which prove to us beyond doubt that whether clockmaking can or cannot be classed as " true model engineering," its exponents are at any rate imbued with the true model engineering spirit!

The " Navy Cup "

● AN ADDITIONAL, but pleasurable duty for the judges at THE MODEL ENGINEER Exhibition this year, will be to judge a number of exhibits on the stand of the Royal Navy at the show. During the past few months, Royal Naval establishments throughout the country have been holding model-making contests which may be regarded as preliminary heats, in that the best entries from each contest will be sent to the " M.E." Exhibition. The best entries will be awarded, first, the " Navy Cup," which we are donating for the occasion, and medals and/or diplomas as our judges may decide.

We are very interested and delighted to note this evidence of encouragement of craftsmanship in the Senior Service, and we have high hopes that we may hear of similar moves in the Army and the Royal Air Force. Men in the Forces, admittedly, do not have very much spare time, in the ordinary way; but we welcome the idea that they should be given the opportunity of utilising that spare time, or some of it, in taking up the hobby of model-making.

A " Simplex " Steam Roller Preserved

● REVERTING TO previous notes concerning the existence of certain examples of the Wallis & Steevens inclined-boiler steam-roller, we are interested to learn that a member of the Reading Society of Model Engineers has purchased one. We believe that this is not the first transaction of the kind that has occurred in the Reading society. At any rate, in his latest circular to members, the hon. secretary, Mr. J. Shayler, refers to the purchase of the " Simplex " roller and adds: " Any more, and we shall have no difficulty in staging our own traction engine race. Farmer Napper, look out! "

Knowing a good deal of the lively spirit that permeates our Reading friends, we should not be surprised at anything that may happen. The limits are widely spaced, when we come to think of it, ranging from such a modernistic enterprise as " Co-Co," the 5 in. gauge electric locomotive to the acquisition of old traction engines. Some scope!

The "M.E." Tie Has Arrived !

● FURTHER TO the discussion on the subject of a proposed "M.E." tie which appeared some time ago in these columns, we are pleased to announce that the suggestions of our readers have now borne fruit, and samples of the tie have been submitted for our inspection. The design of the tie incorporates some of the ideas which have been submitted to us, in conjunction with details arrived at after careful discussion with manufacturers. It is produced in dark maroon, with the letters "M.E." in gold colour arranged in a diagonal pattern over the entire visible surface, the effect being distinctive but at the same time quiet and unobtrusive. If possible, samples of the tie will be available for inspection at the Percival Marshall stand at the "M.E." Exhibition. We should, however, like to make it quite clear that although approving the design and welcoming its innovation, we are not the manufacturers or distributors. For the enterprise in putting this tie on the market, we are indebted to Mr. K. R. Whiston, of 8, Watford Bridge Road, New Mills, nr. Stockport, whose advertisement appears in this issue and to whom orders should be addressed.

A Chichester Get-together

● ON SEPTEMBER 6TH, the Chichester Society of Model Engineers was "at home" to its friends of the Southern Federation. The recently-completed locomotive track was, perhaps, the principal feature of the afternoon's proceedings, and several locomotives displayed their powers during the afternoon. A portable car-racing track provided great interest and amusement for visitors, to many of whom it was something quite new ; the little cars behaved splendidly and not too noisily !

Much progress has been made by our Chichester friends in the building of their clubhouse, but there is still a great deal to be done with regard to completing the walls and putting in windows and doors. However, within this building, so far as it has gone, Mr. A. T. Tamplin was putting his fine radio-controlled model "Churchill" tank through its entertaining performance, as at the opening of the "M.E." Exhibition in 1951 ; an additional item on this programme is the throwing out of a highly effective smokescreen.

Mr. F. L. Gill-Knight was demonstrating his electric traction control gear, based on some full-size components acquired through the kindness of the late Mr. Graff-Baker, Chief Mechanical and Electrical Engineer to the L.P.T.B. The relays and contactor gear are all Mr. Gill-Knight's own construction, and the whole exhibit is most interesting to watch in operation, and could be applied to the control of a miniature electric locomotive for 5-in. gauge, or larger, either from the trackside or actually mounted on a vehicle behind the locomotive.

Last, but by no means least, a 7 n.h.p. Burrell single-crank compound traction engine, No. 3586, built May, 1914, in excellent condition, was standing not far from the main entrance to the ground. She belongs to Penfolds, of Barnham, and was in steam, having come from her home to Chichester earlier in the day. She stood out of gear, but with her flywheel revolving to the old familiar "tuff-ter, tuff-ter, tuff-ter" of the exhaust at about 120 r.p.m. while she rocked gently backwards and forwards in time with it.

Altogether, it was a memorable and most enjoyable gathering, of which Chichester may well feel proud.

Mr. Farmer's 2-in. Scale G. E.R. 4-4-0

● WE HAVE received a letter from an old friend of THE MODEL ENGINEER, Mr. H. C. Waller, of Farningham, Kent. Referring to a "Smoke Ring" published in our issue for August 14th, he writes :—

"I was the purchaser of the partly-made 2-in. scale locomotive made by Mr. Farmer of the Great Eastern Works, and fully intended completing this perfectly-made chassis ; but my business then was taking up so much of my time that I was unable to carry on with the locomotive.

"A gentleman from Beckenham, whose name I cannot remember, but I know he was a Potato Merchant in a large way at the Borough Market, worried me to let him have it in exchange for a very nice 1½-in. scale traction engine. He passed away about four years later, and I often wondered what became of the locomotive, but have never seen it mentioned anywhere as a completed model. I also should like to know if it is still in existence."

So here we have a little further information, and we wonder if we shall eventually discover some more ; a 2-in. scale locomotive chassis can scarcely vanish into thin air !

News from Otago

● MR. H. RIDDLE, hon. secretary of the Otago Model Engineering Society Inc., has been good enough to send us a copy of a brief report of the society's activities for the year ending June 30th, 1952. There appears to be little doubt but that the members are enthusiastic and very active. One thing which interests us is that, owing to certain difficulties arising, the Junior section decided unanimously to amalgamate with the Senior section. We learn that this arrangement works well and that the boys can be depended upon to toil hard and enthusiastically when a job of work has to be done. We can see no reason to suppose that the arrangement would work in any other way, provided that the boys are under proper supervision. There is everything to be said for allowing the younger members to feel a certain sense of responsibility ; it adds to their interest and it stimulates a feeling that they are members of a team with a common object in view, which is all to the good in any society. Left to their own devices, even though they are members of a society, well—boys will be boys !

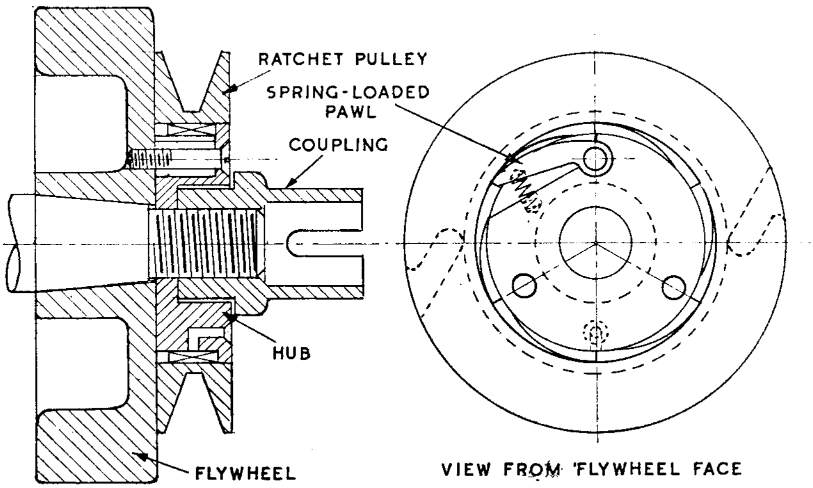
Another thing revealed by the report is that the Otago M.E.S. now possesses a first-class compressor ; the foundation for a steaming-up shed, and timing gear for the car track, all these made possible by the unselfish effort of certain members. Which all goes to show that our friends in far-away New Zealand are just as determined as model engineers elsewhere to keep well abreast of the times. Good luck to them for the present year's working !

A SIMPLE RATCHET STARTER

Interesting machining operations in the construction of a useful petrol engine accessory

by Edgar T. Westbury

DESPITE the prevalance of starting difficulties with small i.c. engines, it is a surprising fact that their users are, and always have been, very apathetic about fitting any device intended to facilitate starting. The time-honoured method of using a belt or a string on a plain pulley, or sometimes just wound on the rim of the flywheel itself, is still almost universal, but although this primitive device can, and does, serve its purpose when conditions are favourable, being that " they only provide something else to go wrong." I am always dead against complication for its own sake, but things only go wrong if they are incorrect either in design or construction, and the extra work entailed in such a device is insignificant compared with the benefits it confers. The device now to be described is an extremely simple one, with the minimum of working parts, but it has proved quite practical, and has definitely solved a very acute starting



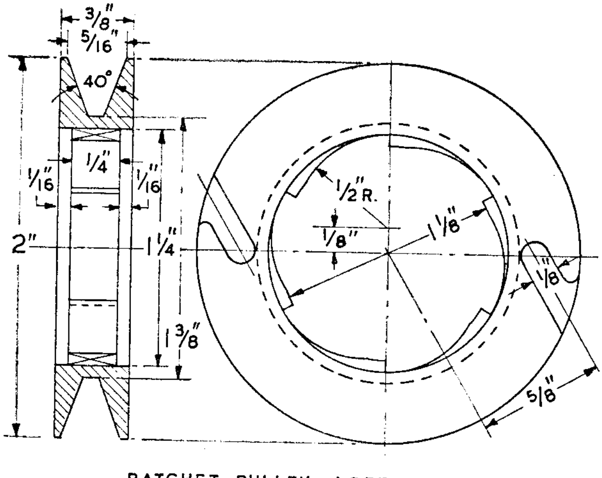
General arrangement of flywheel and ratchet starter

I have always contended that it does not give a small engine a really fair chance. One can rarely be certain that a primitive carburettor will produce a combustible mixture in one or two revolutions at most, or that it can be guaranteed to fire with a cold and possibly oily plug. The critics of the small i.c. engine make a good deal of its non-starting propensities, but there is abundant evidence that these engines can be made to start promptly and certainly if handled in the right way. Personally, having observed the starting technique of innumerable users of these engines, I am often inclined to marvel that they ever start at all!

On several occasions in the past I have described improved starting devices for i.c. engines, including free-wheel self-winding pulleys such as are often fitted to larger engines for industrial work. Little enthusiasm, however, has been shown for such refinements, the general opinion

difficulty. My main reason for devoting an article to its construction, however, is that a ratchet or " free-wheel " of this type has many applications in small engineering practice, apart from its use as a starter, and that it involves some very interesting machining operations.

A friend of mine has a petrol engine installed in a cruising boat, and has encountered great difficulty in getting it started. The makers of the engine had provided nothing further than a shallow groove in the crown of the flywheels, with a hole into which it was intended that the end of a thin cord could be threaded, to anchor it as it was wound on. For reasons which need not be explained here, the use of a round belt *a la diabolo* was impracticable, even if an additional vee pulley to take it had been fitted. The accessibility of the engine, in a decked hull, was a good deal inferior to that available in the usual hydroplane, and the only way in which the cord



RATCHET PULLEY. 1 OFF M.S..C.H.

a self-winding starter incorporating a chain and free-wheel, which has been in service for many years, and rarely fails to do its job efficiently. In the present case, however, something much smaller than a standard free-wheel was necessary, and it was also desirable to make it as light as possible, yet robust in its working parts.

It will be seen that the ratchet itself consists of only three parts, not counting the flywheel or the coupling, which are necessary components in any case, though they had to be made specially in the particular circumstances. If, however, the existing flywheel has a flat outer face, and the length of the shaft extension allows of sandwiching the ratchet hub between the flywheel boss and the normal nut or coupling, these parts need not be specially made.

could be wound was by turning the engine backwards against compression, which could only be done from the propeller end. Consequently, winding the string was a tedious and laborious business, and when it was done, it would only serve to turn the engine over about two revolutions—if the end of the string did not slip out of the hole!

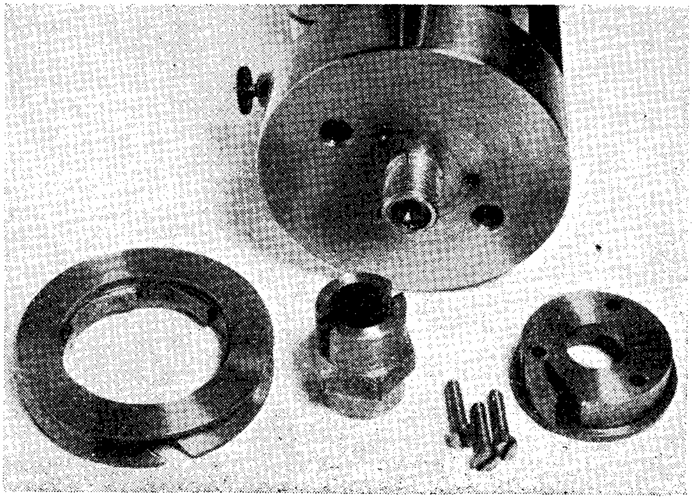
My diagnosis of this trouble was that some means of simplifying the winding of the string was most desirable, to say the least, and also that the circumference of the drum or pulley should be greatly reduced, to enable the engine to be turned much more rapidly, and for a greater number of turns, at a single pull of the string. Hence the use of a ratchet gear, which avoids the necessity of turning the engine to wind the string, and a small, deep-grooved pulley, with hook slots to engage a knot in the end of the string, and release it quite safely at the end of the run. These provisions are not the product of any great ingenuity or inspiration, but are simply a matter of common sense—but what an *uncommon* commodity this seems to be nowadays!

Design of Ratchet

The best-known example of a ratchet gear in small practice, apart from the winding gear of a clock or watch, is a cycle free-wheel, a most ingenious and well-made component whose merits are often ill-appreciated by its users. It has in some cases been found possible to use a cycle free-wheel as an engine starter, either by converting its exterior sprocket to a pulley, or using a cycle chain as a starting cable. I believe that Mr. R. O. Porter's famous cruiser *Slickery* has

The ratchet pulley is turned from a solid piece of 2 in. diameter steel bar, and has the internal teeth machined from the solid. Some consideration was given to the possibility of using a duralumin pulley with an inserted steel ratchet ring, but little, if any, weight could have been saved in this way, and the fixing of the ring might have been a problem. The choice of an internal ratchet may be open to criticism, owing to the difficulty of forming the teeth, as this cannot be done by a straightforward milling process, such as employed in cutting an external ratchet. But the latter could not easily have been incorporated in so simple, compact and rugged an assembly as that shown here, and having constructed many ratchet gears of all types, I think I can speak with some experience in this matter.

It would, of course, be possible to file the internal teeth by hand, and as super-precision



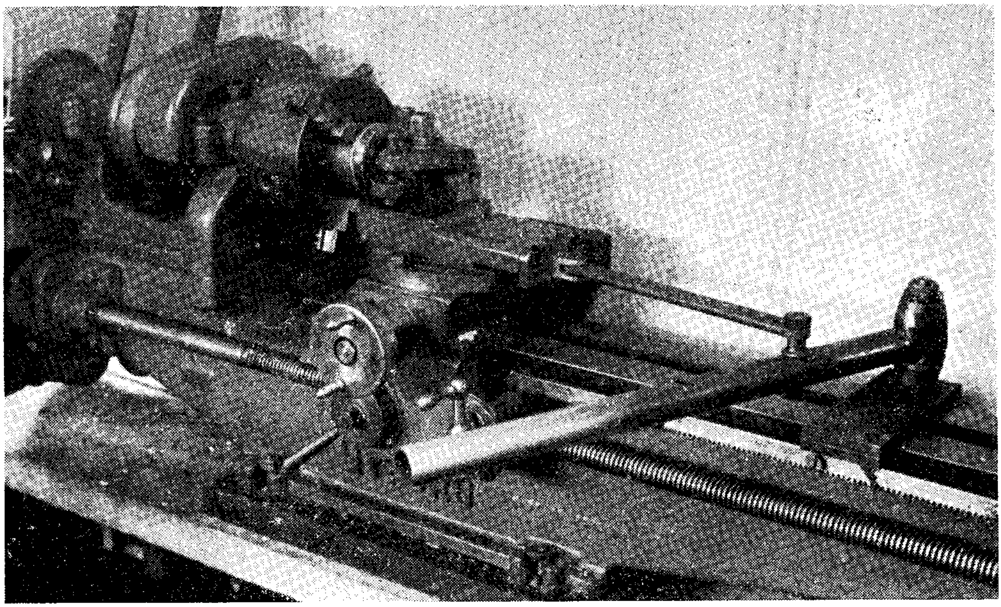
The parts of the ratchet gear, removed from flywheel

is not essential, this would be satisfactory from the practical point of view. But machining processes are much to be preferred, and after some careful thought, a means of producing the teeth by shaping in the lathe was devised and put into execution.

The blank was first held in the three-jaw chuck, sufficient length being allowed to enable all essential machining to be done at one setting. Before doing this, however, the back surface was faced truly, so tha it could be bedded firmly against the chuck face. It was then reversed, faced on the front, skimmed over the outside, the groove " gashed " with a parting tool, and the sides formed (not both simultaneously) with a tool having an included angle of 40 deg. on the sides. The inside was then bored to $1\frac{1}{8}$ in. dia. and both the recesses formed by opening out to $1\frac{1}{4}$ in. at front and back. It may be noted here that the reason for recessing both sides in this way is that it enables the same ratchet to be used for engines of either direction of rotation, by reversing the pulley and providing hook slots in the open side as required. The $\frac{1}{4}$ in. wide tooth face is quite ample for standing up to wear and stress. To facilitate winding the pulley by hand, the rims of the groove were lightly knurled.

Cutting the Ratchet Teeth

Many years ago, I rigged up a simple slotting and shaping device on my old M.L.4 lathe, and this came in very useful for the present job. I need not go into details about this, as our friends " Duplex " have been giving some information on the subject, and the photograph of the set-up will, I think, show clearly how it is arranged. Note that the operating lever is connected to the top-slide of the lathe, the feed screw of the latter having been removed ; this avoids the extra friction of moving the main saddle, and also reduces spring and backlash by applying power as directly as possible to the cutting tool itself. An incidental advantage is that the saddle can be positioned so as to act as a stop, preventing a risk of a dig-in at the end of the travel, which might damage the tool.



The set-up for shaping the internal ratchet teeth

The work is held in the chuck, and indexed in the required number of positions by means of a 60-tooth change wheel on the mandrel. In order to facilitate observation of the work, the tool was arranged to cut on the rear side ; this, incidentally, ensures that the load is taken on the solid side of the slide-way, and not on the adjusting gib. It is essential that the tool should run out into a clearance groove, to clear the chip, and this is provided by the inner recess.

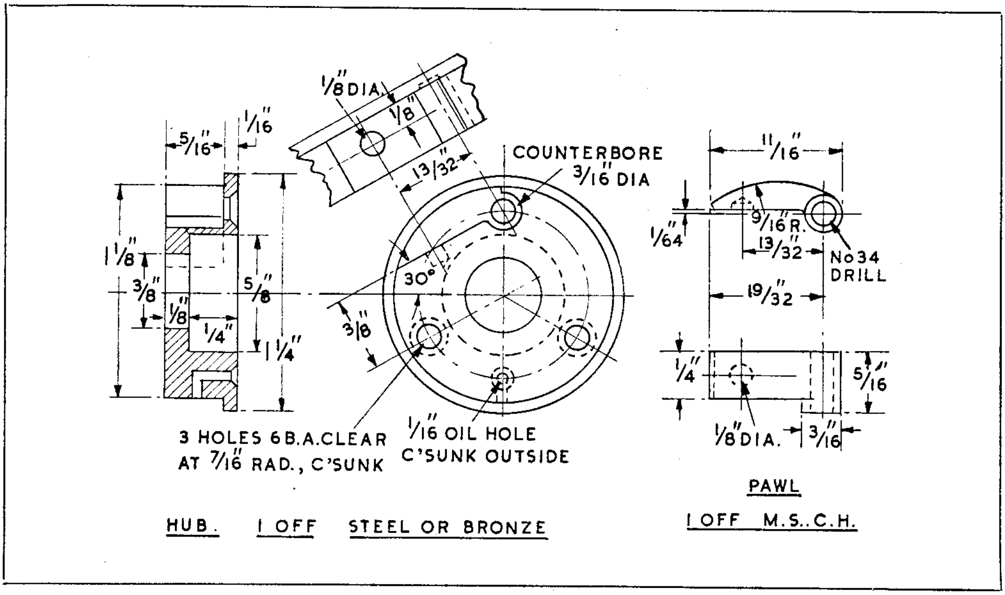
A square-ended slotting tool (comparable to a parting tool on end), $\frac{1}{16}$ in. wide, was used for the first slotting operation. It was set up exactly at centre height and raked at an angle of about 10 deg. (in plan view) to give clearance, the " top rake " angle of about 15 deg. being added to the 10 deg. in grinding the front edge. The work was indexed in six positions, and a cut $\frac{1}{16}$ in. deep taken in each, only a very small in-feed being taken at each stroke to avoid the risk of digging in, and depth measured on the feed screw index.

A $\frac{1}{8}$ in. round-nosed tool was then substituted for the square ended one, being set up as before in respect of cutting angles. The work was then indexed *two* teeth of the wheel, and noting the

position of the index when the tool just scratched the surface, a cut was then taken to a depth of 7½ "thou." This was repeated in six positions, the work being indexed ten teeth on in each case. On completing this round, the work was indexed *one* tooth, and a round of cuts 15 "thou" deep were taken at 10-tooth intervals. For each successive round of cuts, the initial displacement of *one* tooth was made, and the depth of cut increased by 7½ "thou." Thus in eight successive rounds, the depth of cut would increase in even increments to 0.060 in., that is, almost to the same depth as the first square cut, thereby producing a basic shape of tooth approximating to a true spiral curve, with a "land" at the end, caused by moving two teeth of the change wheel at the first phase displacement.

This may sound very complicated, but it is much easier to carry out than to describe, and it does not matter which way round you proceed, as the pulley is reversible. The pulley may then be parted off from the chucking piece, and the rear face trued up to make the sides dead parallel. The teeth only need to be draw-filed, to take out the "humps" between the successive cuts, and to complete the job, it remains only to make the slots in the open side of the pulley, which I did by end milling, but it could be done by drilling and filing. Be sure to incline the slots in the correct direction relative to the ratchet teeth!

In order to avoid risk of cutting the cord, the sharp edges of the slots should be carefully removed (a "mousetail" file is a good tool for this job), and neatly rounded off inside and out, being finally lapped smooth with a leather boot-lace impregnated with carborundum paste.



Hub

This may be turned at one setting from a piece of mild-steel or bronze bar, large enough to clean up to 1¼ in. on the lim, the remaining external surface being made a running fit inside the "lands" of the ratchet teeth and the centre hole drilled to fit the shaft. If a drilling spindle is available on the lathe, the three screw holes can be drilled, or at least spotted with a centre-drill, while the job is set up, and it is then parted off and faced on the outer side, the hole being counterbored as shown, in cases where the length of shaft extension is limited, otherwise the nut or coupling may not engage the thread on the latter sufficiently to hold firmly.

The flat is milled at the angle shown, to a line intersecting one of the screw holes but not passing right through it. Before doing this, however, the hole should be counterbored to receive the pawl, using a flat-bottomed drill or end mill. Here is another case where the milling and drilling spindle comes in very useful. A shallow hole is formed in the milled face to take the pawl spring. Finally, an oil hole is drilled in the outer face, and joined up by another at right-angles to it in the periphery of the hub.

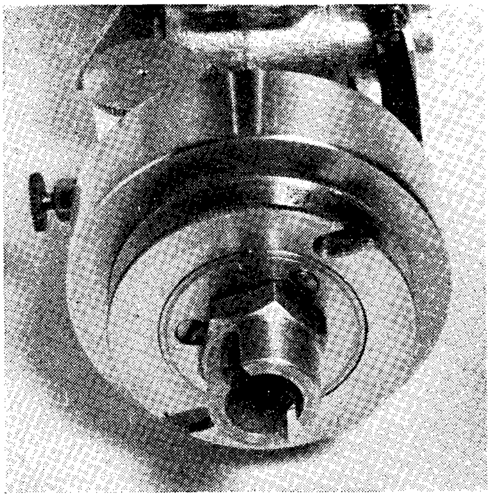
Pawl

While this is quite a small component, it is a very important one. It may be filed up "from scratch" if desired, but its accuracy will be facilitated if it is made from a slide of 1⅛ in. diameter bar $\frac{5}{16}$ in. thick, first marking out and drilling the hole, and then cutting away the unwanted material with hacksaw and file. The boss may be turned by mounting it on a pin mandrel, and this will serve as a guide for filing round the heel of the pawl, so that it fits the counterbore in the hub. Note that by fitting it in this way, the screw which forms the pivot is relieved of shear strain, which is thus taken directly on the hub itself, so that the

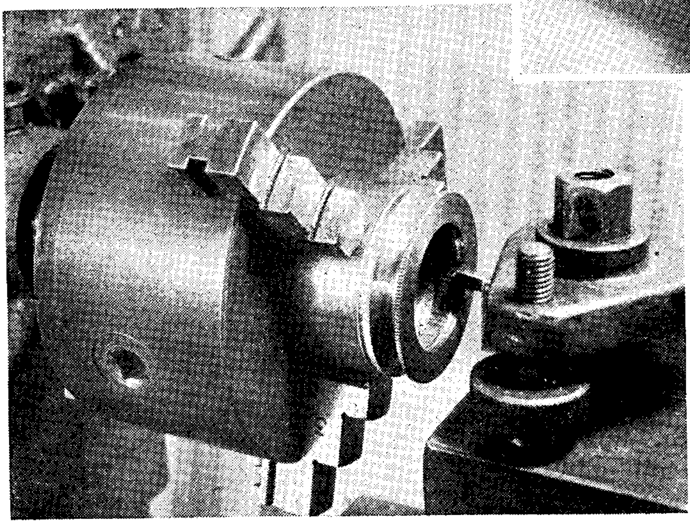
common trouble of a sheared pivot pin is avoided.

A single pawl, as shown, is quite adequate for the work it has to do, but it would be possible to fit three pawls, if considered desirable. A seating for the spring is drilled in the underside of the pawl, to match the location of the seating in the hub. Quite a light spring is sufficient to ensure positive action ; a single strand of fine Bowden wire, wound on a $\frac{1}{16}$ in. mandrel, about six turns, is suitable.

The pawl and the ratchet pulley are finally case-hardened to ensure maximum resistance to wear on the highly stressed working surfaces, and polished before assembly. I made two of these fittings, and one of the pulleys distorted slightly in hardening, becoming just measurably oval, so that it was necessary to oilstone two of the internal teeth to get it to run smoothly.



The ratchet starter assembled on the engine flywheel



A close-up of the shaping operation

When fitted, the pulley proved to be a complete cure for the starting trouble previously experienced. Incidentally, it may be mentioned that the reason for making the groove vee-shaped is so that it can be used either with a knotted cord or belt ; in the latter case it is possible to keep the engine in continuous rotation in one direction as long as may be desired, by working the belt rapidly backwards and forwards.

For the Bookshelf

My Hobby is Watching Trains, by Alan Kendall. (Ilfracombe : Arthur H. Stockwell Ltd.). Fifty-nine pages, sizes 4¾ in. by 7¼ in. Price 3s. 6d. net.

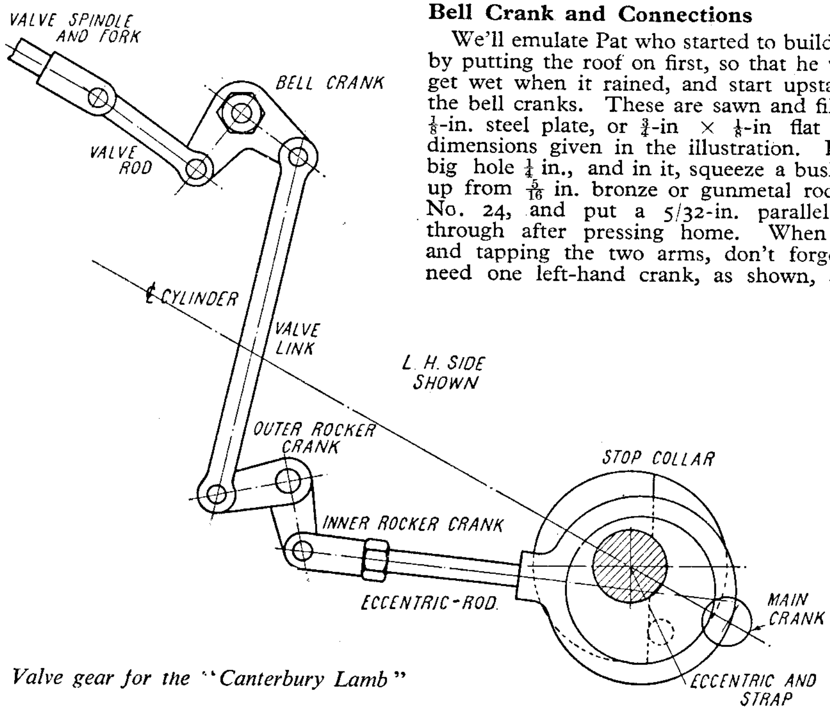
This is a fascinating little book, a kind of autobiography of a railway enthusiast who recounts his personal experiences of watching trains and everything else involved in the operation of railway traffic. It may be somewhat slight in style, but it is eminently readable ; it strikes a personal chord that is certain to find an echo in the heart of anyone who has felt the irresistible fascination of a moving railway train.

The author's story chiefly concerns the trains that passed through his native town of Coventry, or over lines in the surrounding district ; but that district is a fairly wide one, especially after, as a boy, he was presented with a bicycle. Then came long journeys, in later years, made with his service comrades during the war. Always, however, he finds great pleasure in the railway, and that pleasure, as set down in the pages of this book, is infectious !

The "Canterbury Lamb" in $3\frac{1}{2}$-in. Gauge

by "L.B.S.C."

WHILST the valve gear for the "ancient and honourable" isn't such an elaborate box of tricks as the valve gear of *Britannia*, it presented certain difficulties not usually associated with a simple loose-eccentric gear. It didn't even have the advantage of being entirely outside the frames and driving direct from the main crankpin, and when you have to drive valves perched up almost on top of the boiler at the smokebox end, from eccentrics on the driving axle inside the frames, just ahead of the firebox, a certain amount of jerrywangling is called for. However, that doesn't worry old Curly overmuch; valve gears are second nature to me—that's why the locomotives always do the guaranteed job!—and the accompanying illustrations show three views of the whole complete shebang, that will make it perfectly easy to build and erect. Everything is easy *when you know how*! The inside eccentrics drive pendulum levers on the ends of rocking shafts *a la* Swindon, the shafts transferring the movement to rocking levers outside the frames. From the latter, the motion is transmitted "upstairs" by valve links (similar to combination levers in a Walschaerts gear) the upper ends of these engaging with bell cranks, which in turn actuate the valve spindles via short connecting links and forks. Both the rockers and the bell cranks have very substantial bearings; and as long as the pins fit the holes properly in the forks and links, the lost motion will be negligible, and the engine will do the doings.

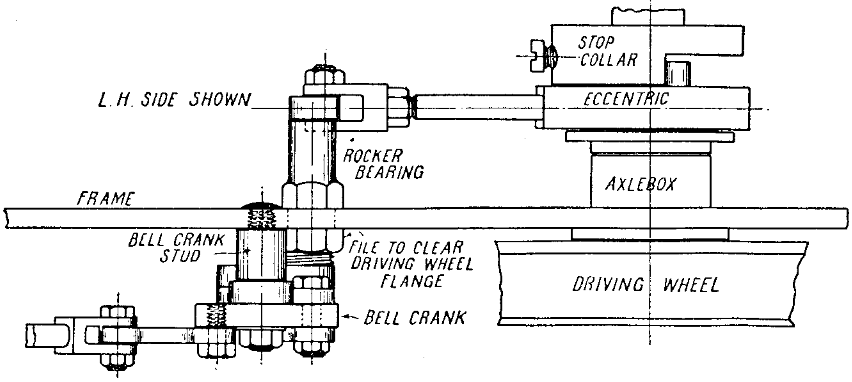


Valve gear for the "Canterbury Lamb"

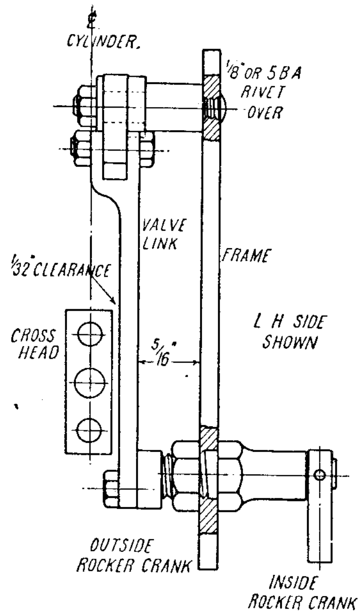
Bell Crank and Connections

We'll emulate Pat who started to build a house by putting the roof on first, so that he wouldn't get wet when it rained, and start upstairs with the bell cranks. These are sawn and filed from $\frac{1}{8}$-in. steel plate, or $\frac{3}{4}$-in × $\frac{1}{8}$-in flat strip, to dimensions given in the illustration. Drill the big hole $\frac{1}{4}$ in., and in it, squeeze a bush turned up from $\frac{5}{16}$ in. bronze or gunmetal rod. Drill No. 24, and put a 5/32-in. parallel reamer through after pressing home. When drilling and tapping the two arms, don't forget you'll need one left-hand crank, as shown, and one right-hand, as the flange of the bush goes nearest the frame on both sides of the engine. The stud on which the bell crank is mounted is turned from $\frac{1}{4}$-in. round steel rod held in the three-jaw; an easy job requiring no explanation, as all the dimensions are shown. There should be a little arch-shaped projection at the top of the frame, with a No. 40 hole in it; tap this $\frac{1}{8}$-in. or 5-B.A. to match the thread on the stud, screw the latter in as tightly as you can, and rivet over the projecting 1/32 in. as shown in the plan view. We can't use a nut, as the boiler barrel almost touches the frames at this point. Put the bell cranks on the studs, and secure with a nut and washer on each. They should swing freely without the least slackness.

The valve spindle forks are made from $\frac{3}{16}$-in.



Plan of valve gear



End view of valve gear

square rod. I've detailed how to make forked ends so many times that further description is superfluous, but I'd like to remind beginners that the best way to drill the hole for the valve spindle, is to set the fork to run truly in the four-jaw, and then centre and drill No. 40, using the tailstock chuck for the job. After tapping, the hole will be true with the centre-line of the fork; and the fork will be true with the valve spindle when screwed on.

The little rod that connects bell crank and fork is a simple filing and drilling job, made from $\frac{3}{16}$ in. × 3/32 in. steel. Don't forget when drilling pin holes in valve-gear parts, always to drill a pilot hole with a smaller drill, and put the correct one through afterwards. In the present instance, use either No. 44, or a 5/64-in., and finish with No. 41; or if you want a specially posh fit, use a 3/32 in. parallel reamer instead of the No. 41 drill. The eyes can be case-hardened, as fully described for *Tich*; but it doesn't really matter, because the little rods can be bushed when they eventually show signs of wear. Connect the rod to the fork, by a pin made from 3/32-in. silver-steel, screwed at both ends and nutted. Connect the outer end to the bell crank by a similar pin, with a nut on one end only, the other end being screwed into the tapped hole in the bell crank; see plan view.

Rocker Shaft and Bearing

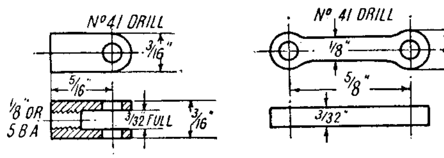
Now we'll go down below, and fix up the rocker shaft and bearing. The best material for the bearing is a piece of $\frac{3}{8}$-in. hexagon bronze or gunmetal rod, but brass will do, if nothing better is available. Chuck in three-jaw, face, centre, and drill No. 23 for a full $\frac{3}{4}$ in. depth. Turn down 9/32 in. of the outside to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. Part off at a full $\frac{7}{16}$ in. from the shoulder. Reverse in chuck, holding by the end of the hexagon, or in a tapped bush, just as you fancy; turn the end to $\frac{1}{4}$ in. diameter for about $\frac{5}{16}$ in. length, and run a 5/32-in. parallel reamer through. Make a $\frac{1}{4}$ in. × 40 nut from a bit of the same material.

The rocker shaft, or spindle, is a piece of 5/32-in. round silver-steel a full 1 in. long. The rocker cranks are filed up from $\frac{1}{8}$ in. × $\frac{1}{4}$ in. mild-steel, and drilled as shown. The end of the outer one is tapped, and the end of the inner one just drilled. Press the tapped one on to the end of the shaft, brazing or pinning it, just as you desire. Now push the bearing through the $\frac{1}{4}$-in. hole in frame, and put the nut on outside; note—if the nut comes too close to the driving flange, with a risk of touching it when the axle-boxes lift on a bit of rough road, file a little off one of the facets of the nut, and set this next to the flange. Hold it in that position whilst you turn the bearing, using a spanner on the hexagon part for a final tighten-up. Then push the rocker shaft through, and put on the inner rocker crank, setting it at right-angles to the outer one, and pinning it as shown. If it is very tight to press on, ease the hole slightly with the

"lead" end of a 5/32-in. parallel reamer. If the cranks are set at right-angles "by eye," it will be quite all right (unless the builder has just made a signal stop at the Railway Tavern!) as the final adjustment of valve gear is made on the eccentric rod forks. The shaft should work freely, without the least slackness.

Valve Links

The next item is to connect up bell cranks and rockers with a pair of valve links. They can



Valve fork and rod

be made from ¼-in. square rod, in which case there will be a fair amount of milling or filing, to thin down the links to the given dimensions; or they can be made from $\frac{3}{16}$-in. × 3/32-in. strip steel, with a little block of steel brazed on one end to form the fork. This wheeze has been fully described in dealing with other engines. In either case the fork is formed in the usual way, by clamping the metal under the slide-rest tool holder, and running it up to a ⅛-in. saw-type cutter on a stub spindle held in the chuck. The rest of the rod is filed to the outline shown. The forked end of the rod embraces the bell crank, and is secured to it by a bit of 3/32-in. silver-steel nutted at both ends, same as the valve-spindle fork. The lower end is attached to the outer rocker crank by a silver-steel pin with a single nut, same as the little valve rod is attached to the bell crank. Some folk prefer to turn these weeny pins from hexagon steel, leaving sufficient "plain" under the head, to form a bearing, and screwing the part that goes into the crank; but turned mild-steel pins aren't in the same street, when it comes to wear resistance, with pins made from bits of silver-steel with a head made from an ordinary commercial nut screwed on, as above. In the present case, there is no need to reduce the ends of the pins, for the purpose of using smaller nuts; they weren't so fussy in the days when the ancient dame was a gay young flapper! The problem at that time, was to get the engines to *go*; personal appearance was an "also ran."

Just one item, lest we forget. Mr. I. Knowitall, of So-and-so S.M.E., gleefully pointed out to one of my correspondents, that the outer rocker crank between the wheels, was shown in its highest position (it was) and when the valve had changed ends, and the rocker crank came down to lowest position, it would foul the flange of the leading wheel. What a wonderful sense of anticipation! What he did was to jump to the conclusion—in his eagerness to catch me out!—that the rocker crank was flush with the frame; well, it isn't, as you'll see by the drawings. The rocker shaft bearing stands out $\frac{3}{16}$ in. clear of the frame, so that the rocker crank not only clears the flange of the wheel altogether, but is well away from the wheel tread. This naturally packs out the vertical valve link, which works on the outside of the crank; and this only allows 1/32-in. clearance between the valve link and the crosshead, as the latter passes it. This, however, is ample. The learned gentleman in question also pointed out that the valve link would foul the bracket supporting the guide bars; he didn't wait to see if I would provide against that contingency! All you have to do, is to file a nick in the bracket just large enough to allow the valve link to clear it. You'll see the exact place to file the nick, when erecting the gear.

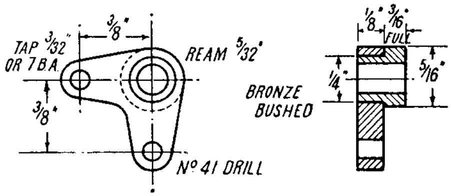
Eccentric Rod and Fork

The eccentric straps, which are just plain rings with a boss for the rod, should be already on the sheaves; so all you have to do, is to cut two pieces of ⅛-in. round steel rod, each 1⅛ in. long, put 5/32 in. of ⅛-in. or 5-B.A. thread on one end, $\frac{5}{16}$ in. of ditto on the other, and screw the shorter ends into the tapped holes in the bosses of the straps. Then screw an ordinary commercial nut down to the end of the thread on the other end; make up two forks, just the same as the valve spindle forks but $\frac{1}{16}$ in. wider, as shown, screw them on to the rods, and Bob's your uncle as far as that job is concerned. The forks are connected to the inner rocker cranks by a nutted 3/32-in. pin through each, same as the forked joints already mentioned.

By the way, I have received complaints from several builders, that the castings supplied for eccentric straps are of the usual pattern, with lugs on the sides. Well, what of it?—bless my heart and soul, a hacksaw and file would have shifted those superfluous knobs and excrescences in less time than it took to write the letter of complaint, and the cost of a 2½d. stamp would have been saved—loud cheers from Solly and Sandy!

How to Set the Valves

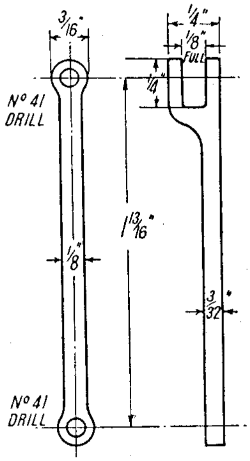
The easiest way for beginners or inexperienced workers to set the valves, is to do it by sight, as



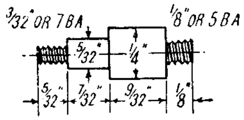
Bell crank

follows:—First of all, the eccentric-rods must be adjusted, so that the ports open an approximately equal amount at each end of the valve travel. Push the stop collar as close to the eccentric as it will go, without interfering with the free movement of the eccentric on the axle; then tighten the set-screw. The position of eccentric and stop collar on the axle, doesn't matter a Continental at this stage; any part of the revolution of the wheel will do. Take off the steam-chest covers, and watch the slide valves as you turn the wheels slowly by hand. If the

port at one end opens more than the port at the opposite end, take out the pin connecting the eccentric-rod fork to the inner rocker crank, and turn the fork whichever way is needed to alter the length of the rod, and equalise the port openings. This is just a simple job of trial and error, which any intelligent kiddy could do. When you have the forks adjusted, so that both



Valve link

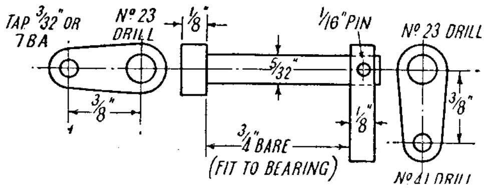


Bell crank stud

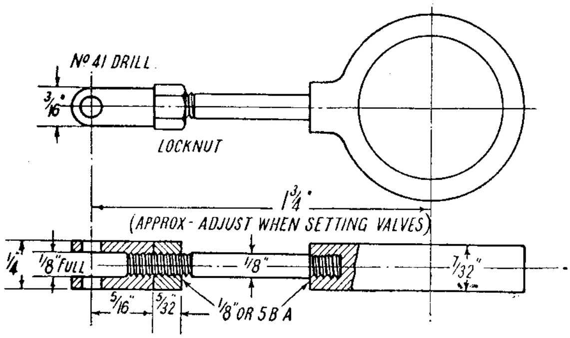
ports are uncovered an equal amount as the wheels are turned, tighten up the locknuts against the ends of the forks, and see that the nuts on the pins are also tight, so that they can't come adrift on the road.

The next item is to set the eccentrics in such a position that the valves just begin to uncover the ports when the cranks are on dead centres, at each end of the stroke. Ease the stop collar set-screws so that the collars can just be moved by hand, on the shaft. Put one of the cranks on front dead centre ; that is, with the crosshead as near to the cylinder as possible, and piston-rod and connecting-rod in a straight line. Turn the corresponding stop collar in a forward direction, until the valve moves forward as far as it will go, then reverses its direction and starts moving back. When the edge of the port shows as a black line at the front end of the valve, stop turning, and tighten the set-screw in the stop collar. Now slowly turn the wheels in a forward direction, until the crank arrives at the back dead centre, the crosshead being as far from the cylinder as possible, and the piston-rod and connecting-rod in a straight line as before. The back port should then be just showing as a black line at the back end of the valve ; if so, the valve is O.K. If it shows at one end, and not the other, only opening at the back end after the crank has passed the dead centre, the valve is a wee bit too long, and a tiny shade must be taken off *both* ends, taking care to have exactly the same length of lap at each end of the exhaust cavity. This is also a matter of trial and error, but a little common " savvy " and patience, will soon do the trick, and the engine will then be O.K. for forward running.

The wheels are then slowly turned in the

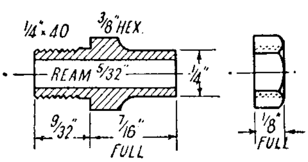


Rocker shaft assembly



Eccentric strap and rod

backward direction ; watch the valve, and as soon as the front port " cracks," stop turning, and take a look at the main crank. It should be exactly on the front dead centre ; if so, the engine will be all right for backward running also, and the stop-collar set-screws can be tightened up " for keeps." If the crank has not



Rocker bearing

arrived at the dead centre when the port cracks, the opening in back gear is too soon, and a little bit must be taken off the shoulder of the stop collar where it catches the pin, to make the opening later. This can easily be done by aid of a small chisel, made from a bit of round silver-steel, which is far quicker and just as effective as taking off the stop-collar and filing it. If the crank has passed the dead centre when the port cracks the valve is not opening the port soon enough, and the eccentric needs advancing a little. Turn the crank back to the dead centre,

(*Continued on next page*)

A New Multi-Purpose Machine Tool

WE have recently witnessed a demonstration of a new machine tool which is adaptable for a variety of purposes, including drilling, grinding, sawing, filing and milling. It is of continental manufacture, and comprises a motorised power-head, mounted on a vertical pillar with rack and pinion adjustment and locking clamp. The pillar is supported by a cast base, incorporating a drill table with vertical sensitive feed.

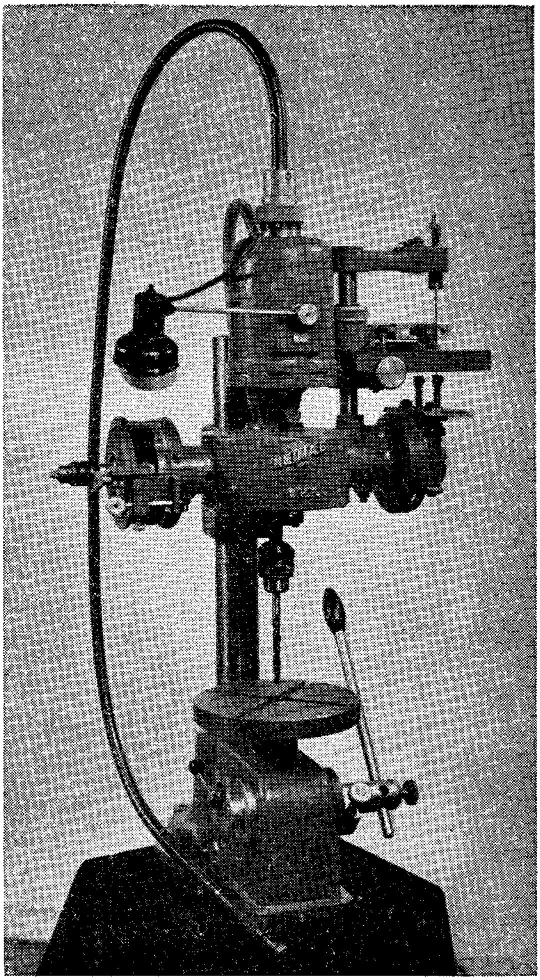
As a drilling machine, the drill spindle is gear-driven from the motor shaft, and runs at a speed of 550 r.p.m. A drill chuck having a capacity up to ⅜ in. is fitted. The sensitive feed has a maximum travel of 4 in., and is equipped with a measuring index and a dead stop. Futher height adjustment can be obtained by shifting the power-head.

For grinding, a geared horizontal spindle is provided, with a grinding wheel 4 in. diameter running at 2,900 r.p.m. An adjustable tool rest and wheel guard are fitted, and the end of the spindle can be provided with a chuck or a taper-screwed spindle for polishing mops.

The sawing and filing head is reciprocated by an enclosed crank, driven by another horizontal spindle, and has a table 5 in. by 6 in., with rack adjustment over a vertical distance of 3 in. An adjustable fence and a work guide are provided, and separate holders are used for saws and machine files. It works at a cutting speed of 18 ft. per min.

At the top end of the motor shaft, a power take-off is provided for a flexible shaft, equipped at the other extremity with a chuck for rotary files, milling tools and abrasive wheels. It runs at a speed of 2,900 r.p.m. All the power spindles are provided with clutches, so that only those actually required for use can be engaged, and wear and tear thereby minimised. The motor has a consumption of 150 watts, and may be either of the single-phase type for 220 volts a.c., or three-phase, for 220 to 230 volts.

This machine, known as the Heimag A5, is marketed in this country by Messrs. G. K. Schenker, 41-43, Praed Street, London, W.2.



The Heimag multi-purpose machine tool

"L. B. S. C."

(*Continued from previous page*)

and you will see a little gap appear between the shoulder of the stop collar, and the pin in the eccentric. A little square of brass or steel, just thick enough to fill the gap, must be soldered to the shoulder of the stop collar, to put matters right; however, if the measurements given for stop collars, eccentrics, and valves are carefully followed, I don't think you'll have any need for jerrywangling, as the setting should come right, first time of asking.

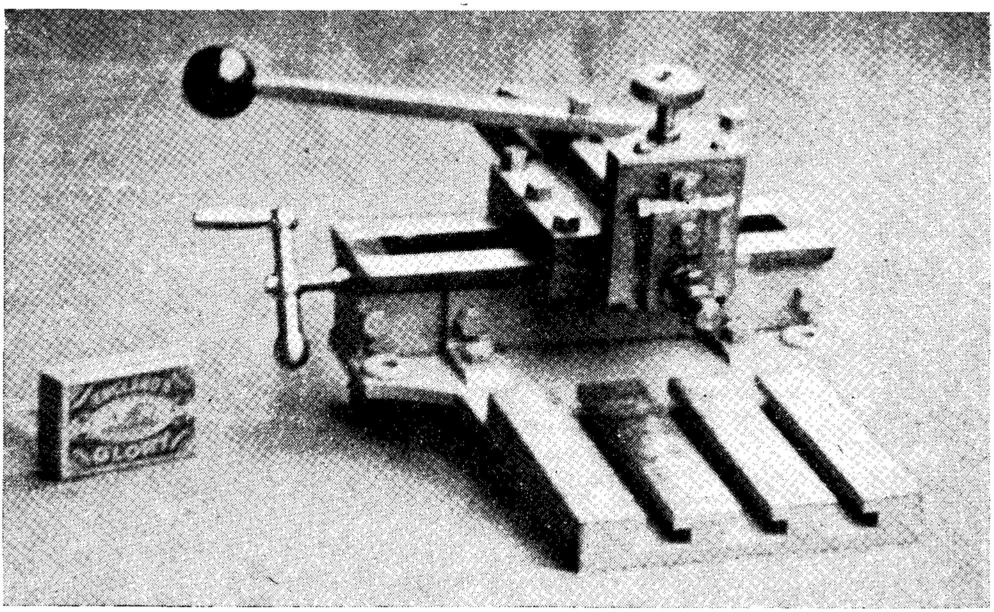
To sum up, when the ports crack at each end, as the cranks arrive at the corresponding dead centres, whichever way the wheels are turned, the valve setting is correct, and the steam-chest covers can be replaced. If a tyre pump is temporarily connected to the steam-chests by aid of any odd bits of pipe that may be handy—Mr. Heath Robinson would have loved that job—the wheels should both "tick over" or spin like a buzz-saw, according to how the pump is operated, and working equally well in either direction. Next stages, lubricator and boiler.

A SMALL SHAPING MACHINE

by E. H. Knight

THE following description of the making of a shaping machine may be of interest to quite a few persons similarly placed to myself. I trust it will also interest other readers of THE MODEL ENGINEER.

For quite a long time I have found that hack-sawing and filing can become very tiresome, especially if there is quite a lot of it to do, and I thought that by using both tools in a big effort to make a tool that would to a certain extent eliminate an arm-aching job, I should at least achieve something beneficial.



General view of the shaping machine

It will be noticed from the drawings and photographs that the shaper is designed for a left-handed person. In fact, there was no alternative; I lost my right arm many years ago.

The materials used in the construction of this machine are wrought iron and mild-steel, mostly scrap, as is usual these days.

Measurements are as follows: table $4\frac{3}{4}$ in. by $4\frac{1}{4}$ in.; stroke, 3 in.; depth of feed, $\frac{1}{2}$ in.; cross-feed, 4 in.

Vee-slides and guides are fitted to all working parts and the fitting such that no gib-strips are required for the time being.

The baseplate is of mild-steel plate and the T-slotted table was formed by inserting $\frac{1}{4}$ in. strips between the baseplate and wider $\frac{1}{4}$ in. strips which form the table top.

The box bed carrying the traverse slide is built from two wrought-iron strips each 7 in. by $1\frac{1}{2}$ in., the ends being closed by two pieces of the same material—$1\frac{1}{2}$ in. by 1 in. Both pieces are drilled through their centres and are bolted into position between the wrought-iron strips with two $\frac{1}{4}$ in. Whitworth bolts and nuts. These hex. bolts and nuts, together with all the other bolts, nuts and set-screws, were made on a lathe I made 30 years ago and a little while after I sustained my physical disability.

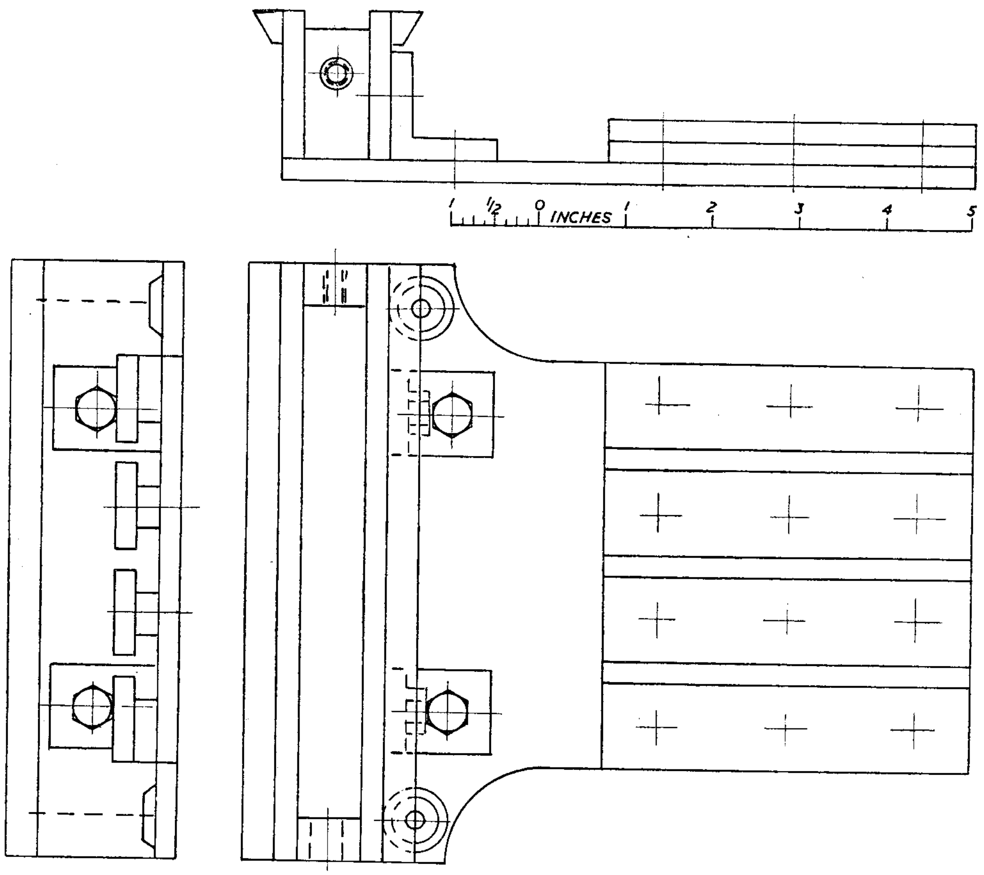
The end pieces were then drilled, one to accommodate the journal of the traversing screw and the other to receive the adjusting cone. The vee-slides were hacksawn, filed and scraped from a piece of $\frac{3}{8}$ in. wrought-iron bar and screwed to the box by $\frac{1}{4}$ in. set-screws. After lining up, this part was fixed to the baseplate by set-screws and further secured by angle brackets.

I then tackled the ram; this is also a bar of wrought-iron. More sawing, filing and scraping to form the slides. After being passed as satisfactory, a bracket was made and riveted to one end to accommodate the ram-head. A shaped strengthening strip was riveted to the slide, which also adds to the appearance.

The lever which operates the ram is another piece of wrought-iron 8 in. by $\frac{1}{2}$ in. by $\frac{1}{4}$ in. It is furnished with a ball grip screwed to the

tapered end. It was turned from wood and painted black.

Now for the tool or clapper box—more scrap wrought-iron. The front plate is $\frac{1}{4}$ in. thick and a vee-strip is riveted to this on either side. The tool-holder was made from an old $\frac{5}{8}$ in. diameter mild-steel bolt. It accommodates a square tool-spigot. For a back plate the same section of hexagon nut. The knurled handwheel was made bits of $\frac{3}{16}$ in. section and is fixed to the clapper plate by means of a screwed and shouldered from a short bar end, the centre hole being squared after drilling to fit the square machined on the feed spindle. A 3/32 in. hexagon Whitworth set-screw and washer holds the wheel in place.



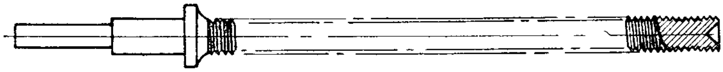
Details of the baseplate and table

material is used, being shaped to slide fairly tightly between the strips on the front plate. To this back plate another plate is riveted, being drilled and tapped to accommodate the $\frac{1}{4}$ in. Whitworth feed screw which I turned from a short length of $\frac{1}{2}$ in. diameter mild-steel bar, starting the thread by means of a tailstock die-holder, and afterwards finishing the thread with hand tackle in the vice.

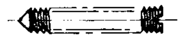
After providing a top plate for the tool box and securing this to the ends of the vee-strips with $\frac{1}{8}$ in. Whitworth set-screws, the whole unit was fixed to the ram head with a $\frac{1}{4}$ in. Whitworth crewed and collared spigot and tightened by a

The clapper box was by far the most interesting part to make and, incidentally, took the longest to make. Great care was taken to fit the parts together to permit a good sliding fit of the guides. I nearly forgot to mention that the clapper plate is hinged to the front plate with a 5/32 in. pin. This is kept in position by a hexagon nut. The other end of the pin is formed as a cheese-head.

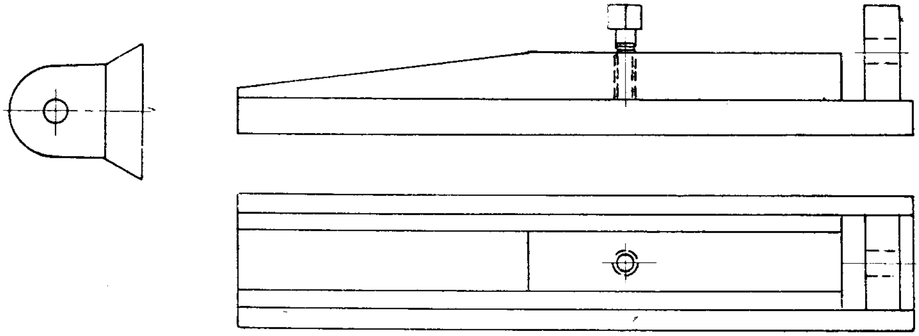
The next consideration was the making of the saddle. This was a fairly straightforward job, and consists of a plate and four vee-strips, the latter being fixed to the former with $\frac{1}{4}$ in. hexagon bolts and nuts. The top pair of vee-strips house the ram and the bottom pair actuates on the ways,



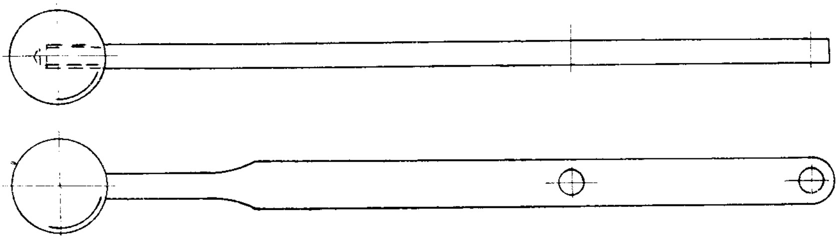
Traverse feed-screw



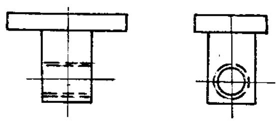
Coned centre



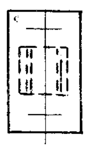
Details of the ram

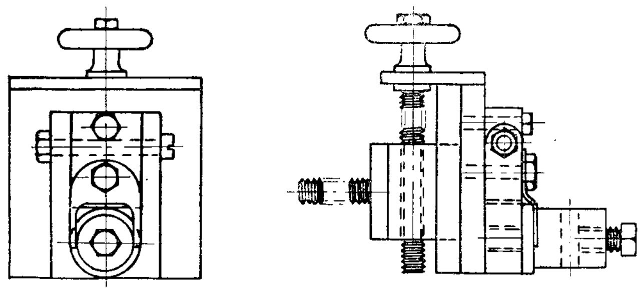


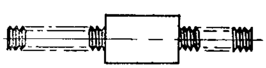
Lever and ball grip



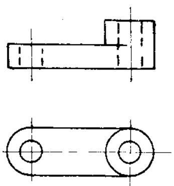
Traverse nut



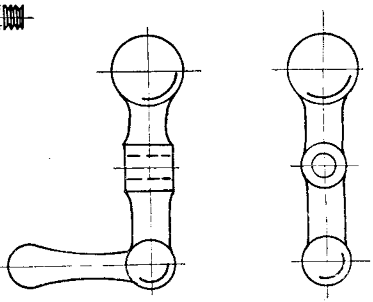




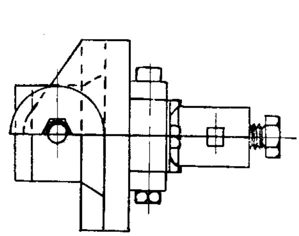
Hinge pin



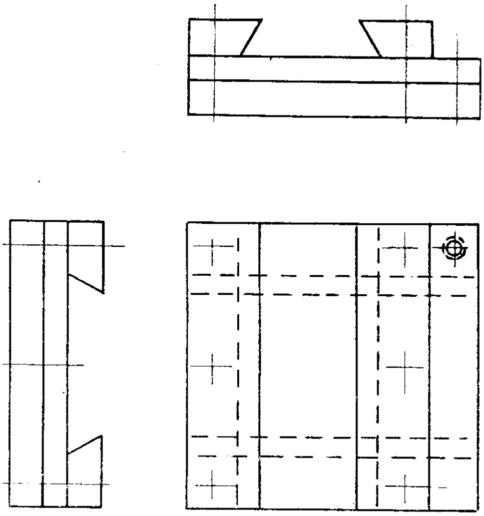
Toggle lever



Handle



Details of ram-head (half size)



Details of saddle

which are mounted on the box bed. A brass nut, shaped as shown, was made and fixed to the underside of the plate with two set-screws, and all that remained to be done was to make the traverse feed-screw. I turned this in the lathe between the centres and wondered awhile how I was going to screw-cut the greater part of its length, as my lathe was not fitted with screw-cutting gear. Obviously, a tailstock die-holder was useless here and I could not see how I could get a true thread (other than by chance) by using a circular die on this occasion. So I thought of another way. I borrowed and old-time two-part die and holder from a friend, the die parts being in good cutting condition. I mounted the spindle in the vice and opened the pair of dies to just clear over the end of the spindle, tightened up and chased a thread for about $1\frac{1}{2}$ in. The dies were then brought to the top of the spindle and re-adjusted. A further cut was taken, this time almost to the bottom. The tool was then removed from the work and finished by using a circular die. The resultant combination of screw and nut works very satisfactorily.

The traverse screw is furnished with a balanced type of handle. This, too, was turned from an old $\frac{5}{8}$ in. bolt. It is fixed to the spindle by drilling through the handle centre and inserting a tapered pin. To take up the thrust on the traverse screw a coned centre is used, being locked into position with lock-nuts.

The Toggle Lever

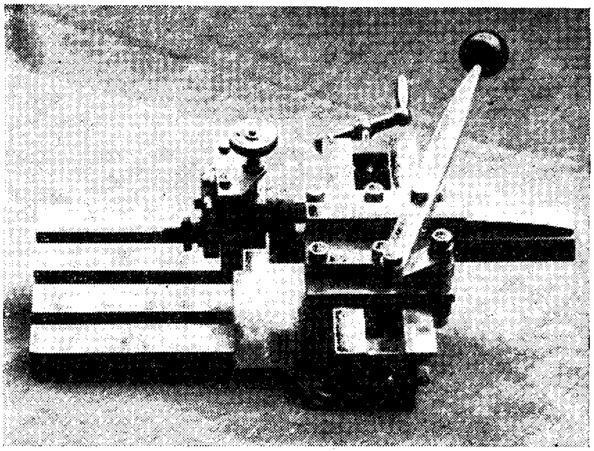
This is shaped from a piece of mild-steel. A specially-made bolt secures the handle to the ram slide and reaches through the strengthening-piece into the ram slide proper. I then turned a few more hexagon set-screws. These were needed to assemble all of the parts together. When this was accomplished, a trial was given to the machine. It dealt with brass and phosphor-bronze quite readily, taking a $\frac{1}{16}$ in. cut without trouble.

Next came the finishing. My own idea for the livery of a machine tool is black enamel, the working parts being polished and kept bright. However, the slogan now is Brighter Britain, so I decided to paint the body turquoise.

The table top is rose finished, the result being brought about by pressing a small square of emery-cloth on to the work and working with a half circular movement, pressure being applied by the thumb.

At Work Again

After its return from the "M.E." Exhibition the machine was put through its paces again. Brass and bronze were dealt with as before but the tool tended to ride when dealing with steel and wrought-iron. This trouble was soon overcome, however, by using a short length of spring-steel, the one end fixed under the nut that holds the hinge pin bracket in position, the other end exerting pressure on the tool holder. This prevents the tool leaving the work at point of contact and permits an even cut along the whole length.



End view of shaping machine

A machine vice, opening to $1\frac{1}{2}$ in., has since been made to work in conjunction with the shaper. It is painted to match the colour of the latter. Later on I intend to make an angle-plate to enable me to machine gear wheels. It will be provided with division plates.

No drilling machine was used to build the shaper. I drilled each hole with a 3/32 in. pilot drill using a breast drill. The holes were then opened out to the required sizes by using a suitable drill held in a carpenter's brace.

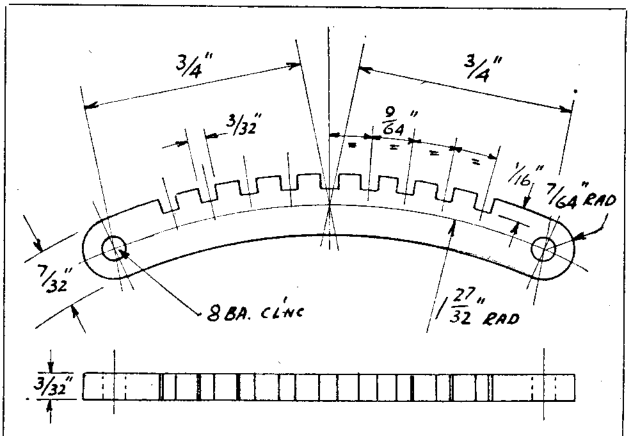
In conclusion I feel there may be many more readers of THE MODEL ENGINEER similarly placed as myself who do work of this description for recreation. If so, I would like very much to hear of their activities.

TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally but very different internally

IN many ways, I hope that those builders who like to get the building instructions finished and done with before the next issue appears, have not yet got to the stage of cutting the notches in the reversing lever sectors ; not that anything is wrong with the information given, but because I had some special comments to make and there was not room in the last article to do so. We had reached the stage of setting the lever unit on the frames, and the reach-rod section was given ; so we can go on from there.



SECTORS 2 OFF – IN STEEL

Once everything is bolted up, the lever is put to the full forward position, and the state of the die-blocks noted. Remember that these do not go right hard down in the expansion links, and a small space is left where the expansion link "track" is relieved to preclude possible jamming or binding at both extremes of travel. Therefore, the lever must be brought back until this condition is obtained, and the sector is clearly scribed for cutting later on. It is just as well, at this stage, to have a look round the other side of the engine to make sure that the die blocks are the same *both* sides ; this is a precaution that was suggested to you some time ago, when the rest of the gear was being described.

To ignore such a discrepancy now would be inviting trouble later on, and, however bothersome it may be to have to start putting this trouble right, exercise a bit of self-discipline, and make yourself do it right away.

Finding the Dead Centre

The easiest way of doing this is to detach, temporarily, both eccentric-rods to leave the expansion links free to swing. Bring the lever back until you can swing the free link without the valve-rod moving at all. Hold that position by means of a cramp on the lever, and then check off the other side. If your work has been done correctly, you should again be able to move the link to and fro without valve-rod movement. Once again, the sector is scribed, for mid-gear position this time, and the eccentric rods may be reinstated for keeps. Finding the full reverse position is merely a repeat of the forward gear method, but with the die blocks at the top instead of the bottom of the expansion links.

And now we come to the anomaly. We now have the three basic positions or extremes, and all that is required is the setting out of the intermediate notches, just as the drawing shows.

Now the prototype has a perfectly even division of such notches, ignoring certain irregularities of valve events caused by the pendulum action of the lifting link on the radius-rod ; whether or not this was a deliberate omission or mistake at the Horwich Works, I shall probably never know, but at least I tumbled to the existence of the irregularity when setting up my own gear. I even went to the trouble of checking out valve events to make quite sure, and ended by spacing out the remaining reverse notches differently from the forward notches, which were even, and just as per drawing.

To put it in a nutshell, the angularity of the motion when in reverse, means that the engine will not run quite as evenly in reverse as it will in forward gear. There is not a great deal in it, and reference to the table on the works drawing, shows that there is, in fact, a very slight difference between the two workings, and I venture to suggest that in actual practice it will take a very keen ear to detect anything amounting to uneven beat.

In order to make the best conditions prevail, I set out the remaining notches a little more closely spaced, so that there is a greater gap between the last intermediate notch and mid-gear. It stands to reason that the space between full gear and the first quarter of the sector, is bound to be of greater use than the mid positions ; in addition to which, it must be remembered that as the lever approaches the mid positions, it requires a *greater movement to have an effect on the valve event itself.*

Continued from page 417, " *M.E.*," *September* 25, 1952.

Cutting the Notches

I can see no particular virtue in going to the trouble of machining these. The notches are so shallow that a small square file will do the necessary in under two minutes per notch—much less than the setting up time. Most certainly bolt both the sectors together to cut them, so as to keep them the same, and if you are going to set the positions unevenly as suggested, that still further makes machining not worth while ; in any case, a little filing will do you good, and I think you ought to keep your hand in, if only for what I have in store for you later on.

Oh, and by the way—there is no need for the catch to be a good jam fit in the notch ; I like to feel just a tiny shade of shake in the lever—it tells me when the catch has dropped home, and it also prevents it sticking in and making a nuisance of itself.

Several times during the building of this engine, I have been near to making mistakes which, if not serious, might still be bothersome. During the fitting up of the reversing lever, I was trying to find the most convenient position for operation, ignoring more or less the prototype details whilst doing so. There is precious little space round the handle of the lever in any case, and on the full size engine there is a pocket in the side tank to accommodate it when in full forward gear—just as we have on our job. There is a lot of difference between a scale hand about the size of a postage stamp, and not much thicker, and a dirty geat thumb and fore finger blundering about inside a tiny cab, and so (thought I) we will bring the lever stand back just a shade to give that extra space that will make operation so much more comfortable.

I did that little thing, and the improvement was well worth the thought given. Later that evening when the cab roof and bunker were in place, my thoughts turned to the cab doors that open inwards . . . *Open inwards* !—A frantic dash for the inside calipers and the swing of the door was simulated past the end of the lever stand—to reveal a clearance of about three thou at the extreme edge ; now if it had been the *other* way, it would have meant alterations to bolt holes, alterations to the nicely finished reach rod and a horrible evening to one and all. The dimension given on the drawing provides a more comfortable margin than that, thank goodness.

Details

There is quite a lot of fun to be had, looking out the details on the full size works drawings, and having found them, setting about the job of reducing them to working propositions. One of these was the steam brake valve, and it looked as though it was going to be a mighty tricky job to get it anywhere *near* a true example of the big version. Fortunately, I had the prototype detail drawing as a separate sheet, and it was drawn full size to help matters. My troubles were only starting then, and a rapid calculation showed that the actual floating disc valve inside would be $\frac{1}{4}$ in. diameter, by about 1/32 in. thick. In this had to be incorporated the spindle with its floating dog drive, a stop peg track, a full port and a porportioning port, cut radially. It looked rather hopeless at the time, but assumed worse proportion when I found that the entire valve, the injector steam valve, and the water clack were all one casting on a single pad on the backhead !

There was only one thing for it, and that was a fabricated job from the start. First, I made the pad back, then the clack and injector valve body, and finally, the brake valve body (what there was of it). Then came the fun of sticking them all together—a pastime I can thoroughly recommend to anyone who has no patience at all ! The usual procedure when building up a number of parts is to pin or screw them together in places where it will not matter, later filing off unwanted screw heads or tops of pins. Assembly may be made easier still by using two grades of silver-solder, to avoid melting out the first batch of joints.

Here was a case where there was hardly enough room for the working parts, let alone spare spaces in which to put pins or screws ; so I made up each part with a little extra metal where it joined up to its nearest neighbour, and by the judicious use of the old faithful four-jaw chuck, turned a tiny spigot a push fit into a short corresponding hole in its mating part. The push fit was reasonably tight ; heating up often causes unequal expansion, and you find that parts start to fall off.

The application of silver-solder was also on a generous scale, with the result that all the joints came out with nice flowing fillets of metal between them, and at least an hour was spent with an assortment of fine Swiss files, blending in here and there, and working down hard corners to simulate the general casting effect. Altogether the result was most pleasing, and I was encouraged to continue.

The first attempt to make the disc valve was an abject failure. I made the mistake of turning the disc and its spindle as one piece, thinking that it would at least provide something to hold it by. Under test, the valve leaked badly, in spite of the fact that disc and spindle were turned at a single setting. I believe the cutting of the ports must have upset its truth, but in any case it had to be scrapped, and a fresh start made.

The second attempt meant going the whole hog, with a separate spindle incorporating a driving dog at the end, and a disc having an engaging pin to be driven. The problem now was to hold the tiny slip of a disc whilst cutting the ports, and at least three discs were damaged in some way or other, and had to be discarded.

In final desperation, I partly turned the disc on the end of a piece of rod, and left it there. This meant cutting the ports " blind "—something I didn't want to do in stainless steel, and with an *end-mill only* 0.015 *in. in diameter.* After several attempts I managed to secure a satisfactory disc valve, and was jolly sure to remember where I put it. The rest of the job went through without incident, but it was interesting to note that the brake valve alone, including its bolts, pins, spring, etc., totalled 22 separate and distinct parts.

And Other Details

Reading " L.B.S.C." the other day, I noticed some remarks he had to make concerning lamp-brackets—where and where not to put them. It

(*Continued on page* 480)

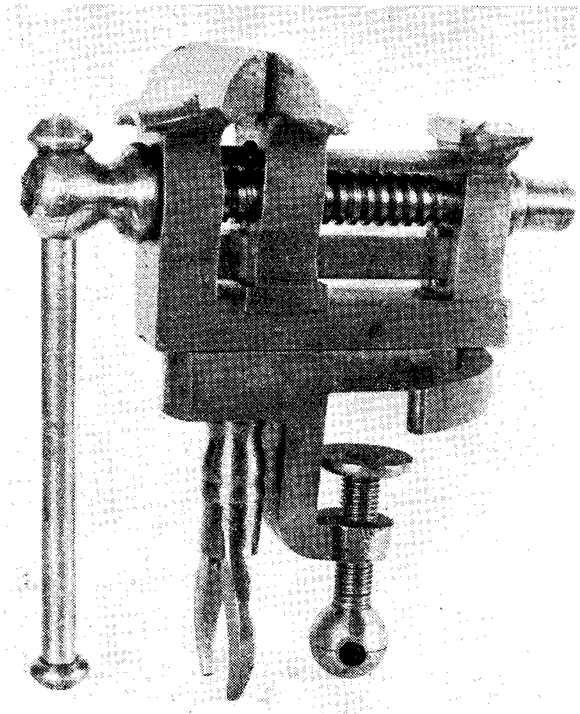


Fig. 1. Showing the general construction of the vice

An Interesting Old Vice

by Ian Bradley

THE subject of these notes is a small bench vice presented by H.R.H. Prince Alfred, Duke of Edinburgh and second son of Queen Victoria, to the writer's grandfather, Captain W. H. Bradley, R.N. This naval officer was navigator in three of Her Majesty's ships: *Scourge*, *Racoon* and *Galatea*, in which Prince Alfred also served and was at the time Captain of H.M.S. *Galatea*.

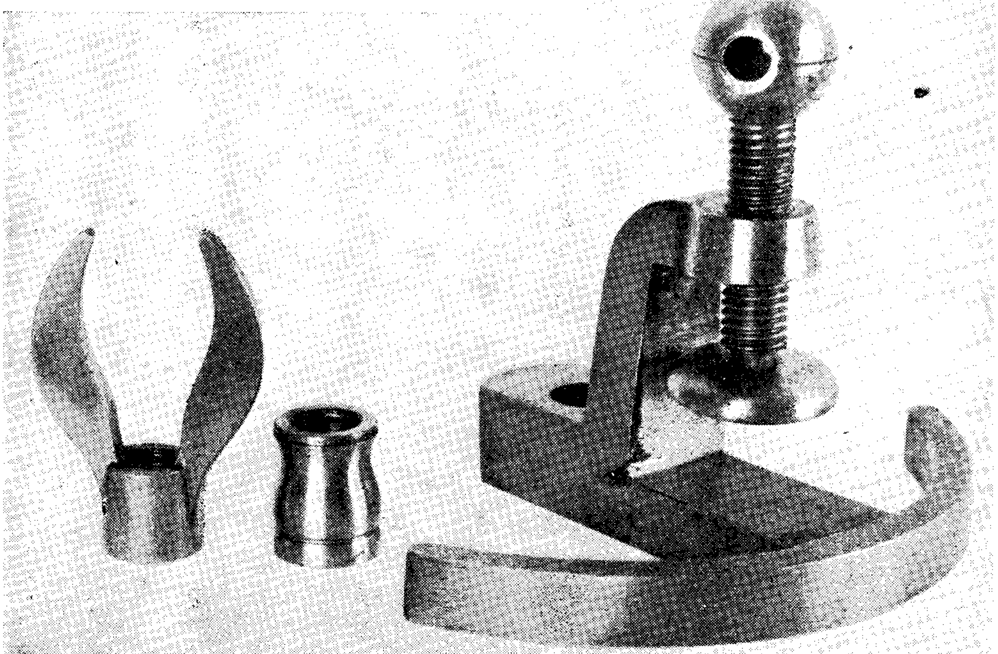


Fig. 2. The bench clamp with the wing-nut and collar for securing the vice

In a letter, addressed from H.M.Y. *Victoria and Albert* and dated 11th January 1872, Prince Alfred writes to Captain Bradley that he has had a toolchest prepared, having himself selected the tools, and hopes that it will be found complete and convenient.

From this it would appear that these two Naval officers had a common interest in workshop matters, and, as far as is known, the tools were purchased from the firm of Holtzapffel.

The writer's father can remember when this chest of tools was complete and in good order, but with the passage of time the contents have unfortunately been dissipated or lost and, apart from a few woodworking tools, only the small bench vice remains.

This vice is of particular interest, as it is of rather elaborate design, and the finish and workmanship generally are outstandingly good and do great credit to the skilled craftsmen of a past generation. The base bracket of the vice, for attachment to the bench, is an iron forging, and to this is pinned and brazed a curved runway for supporting the overhung end of the vice when set at an angle.

The thread of the bench clamp-screw, measuring 10 mm. by 1.5 mm. pitch, is cleanly cut and remains a good working fit in its bracket. The spindle on which the vice rotates is threaded 8.5 mm. by 1.25 mm. pitch for the elaborately-shaped, ornamental wing-nut that serves to clamp the vice base to the bench bracket.

The standing jaw of the vice is forged integral with the base, but the upright for carrying the vice screw, at the other end of the bed, is squared at its lower end and riveted over to give a secure fixing. The upper part of this upright member is forged to form an anvil with two tapered beaks, and a drill hole is also provided to take a metal-working strake.

The moving vice jaw is slotted at its lower end to slide on the base bar, and the jaw obtains further support from a guide bar of square section.

The construction of this guide bar is of interest, for it is formed with a head at the rear end so that it can be firmly secured in the vice-screw upright by means of a tapered cotter-pin.

The vice-screw is 13.5 mm. in diameter and carries a thread of 3.5 mm. pitch. The tail end of the screw is threaded to take a thrust collar, which bears on a washer fitted to the squared end of the spindle. The clamping portions of both vice jaws, $2\frac{5}{16}$ in. in width, are dead-hard, but the rest of these single-piece forgings is left soft ; presumably, the jaws are case-hardened, as there are no inset jaw plates.

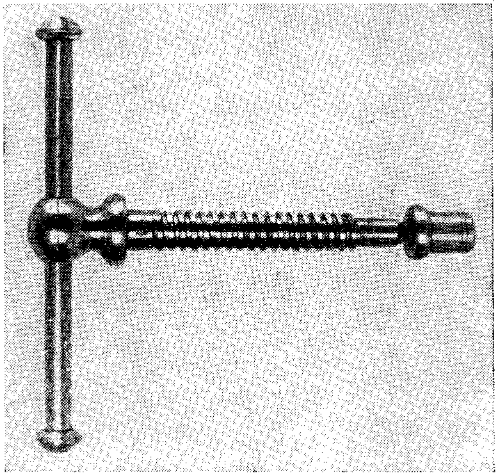


Fig. 3. *The vice screw with its squared washer and thrust collar*

No doubt, in a vice of this quality, castings would have been considered out of place on the score of lack of strength ; this form of construction would, however, have been inadmissible owing to the necessity of having to case-harden some parts and rivet-over others. A noteworthy refinement is the fitting of a curved, sheet-metal chip shield, passing through the moving jaw, to protect the vice screw throughout its length.

None of the threads measured corresponds with any of those of the Holtzapffel standard scale, and the use of metric threads suggests that the vice is of continental origin.

As this vice may be of interest to some visitors, it will be on view on the "Duplex" Stand at the forthcoming MODEL ENGINEER Exhibition.

Twin Sisters

(*Continued from page* 478)

would appear that engines that are confined to yard work, shunting and sidings generally, are not required to carry a lamp bracket either on the chimney base or smokebox top. This leaves the normal three brackets along the front of the footplate, i.e., one right, one left, and one centre.

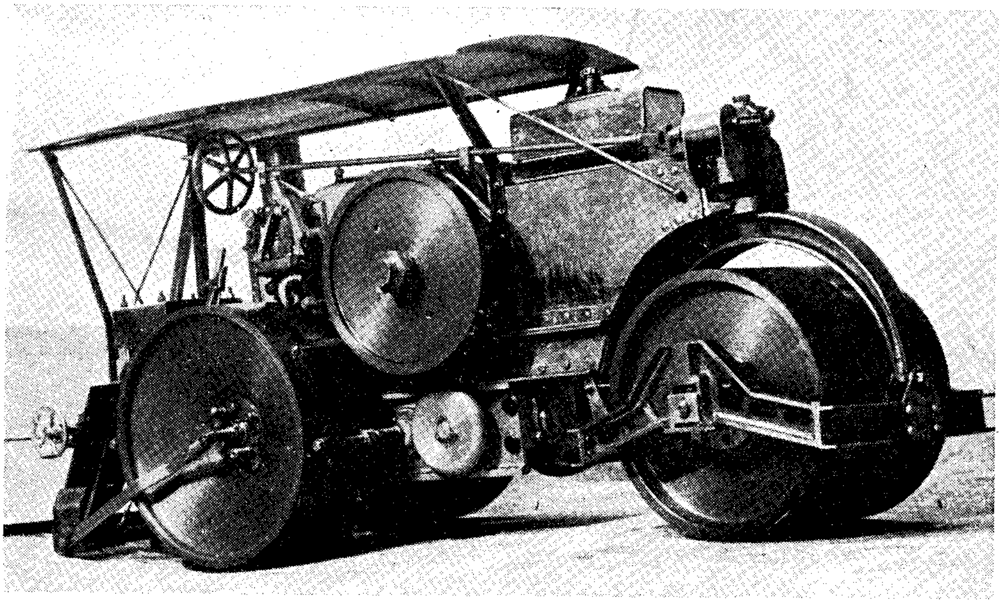
Looking at the works drawing details of the smokebox of our "2F," I see that this conforms to the above. Looking at the official photograph of the same engine, three-quarter front view, what do I see? Clearly, a most decided lamp bracket, well on the top of the smokebox door ; so where do we go from there? If anyone has bothered to keep the first "Twin Sisters" article of January 20th, 1949, No. 2487, of THE MODEL ENGINEER, and cares to look at the picture, he will see for himself.

I'm *not* starting an argument, I only want to know!

(*To be continued*)

The Tale of an "M.E." Road Roller

by J. C. Davis



I SAW the photographs of Mr. Walter's Aveling roller in a recent issue of THE MODEL ENGINEER, and as one on the prototypes was working on the roads of Sussex, I became interested. Mr. Walter thought my capacity was sufficient to have a try and so my first piece of modelling started.

I found that full instructions and drawings had been prepared by Mr. Westbury and machining instructions given. I applied to Bond's for the castings in a personal visit. "No, no, you don't want to buy *all* the castings; try a few and see how you get on." After a month or so another visit: "Oh! Well, you'd better have a few more." I suppose that Bond's experience is of many models commenced and few achieving a finale. However, as it eventually looked, even to them, that the model might be finished, everyone there put their shoulders to the wheel, providing scarce material, etc., and eventually, rather like Dorando finishing the Marathon (assisted and disqualified) the model has crossed the line.

My tools consist of a 1912 4-in. George Adams' R.B. lathe, an 1850 (about) Muckle 5 in. ornamental lathe, and a Champion ¼-in. drill. "George" is a veteran; from where he was, screwed on to the top of the chest in my 6 × 8 cabin, he took part in the Battles of Heligoland, Dogger Bank, and the Dardenelles, and once got a 6-in. gun back into action on the eve of a night sweep off Emden, when no other tool on board could cut that thread.

So, with the capable "George," in 3,000 hours we've finished the model. Of course, "granfer" helped also; those ornamental lathes can mill almost any scrap. The carburettor required some curious motions, but these were nothing to "granfer's" repertoire. There must be a joker in Messrs. Bond's pattern-making shop. "I'll give them something to trouble 'em," and so the scarifier hand wheel, a casting with S shaped spokes was supplied. But "granfer" just chuckled and machined the wheel all over.

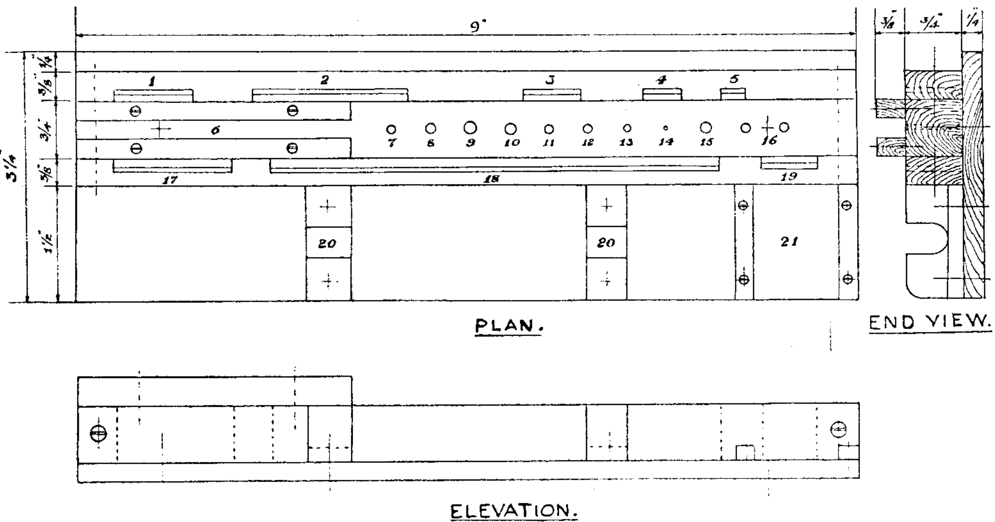
Though credit is due to George and myself, much the greatest credit is due to the designers and draughtsmen. I wouldn't swop jobs.

[For the benefit of many readers who have expressed interest in the "M.E." road roller, we have ascertained that castings and working drawings can still be obtained from Bond's o' Euston Road; castings are also obtainable from Mr. W. H. Haselgrove, of Petts Wood. Since the design was first published in 1938, a large number of these models have been constructed with success by readers in this country and many other parts of the world.—ED., "M.E.".]

A TOOL STAND

by S. F. WESTON

WHEN commencing a job, and with every different section of it, the first step is the setting-out of the work. The more carefully and accurately this is done the smoother and better the assembly of the parts will be. The old workshop rule of "measure twice—cut once" is a good and safe one, and should always be practised.



Naturally, to carry out this work, the proper tools are required, and all of us have our set of favourite tools with which we become familiar and accustomed. If these are mounted on a simple stand, they can be carried to the work on the bench or elsewhere, and as each tool has its place on the stand it can be instantly picked up. The user should endeavour to train himself to always put back the tool in its place after use. This is far better than dropping it on the bench. If this is done, the bench soon becomes littered with tools, mixed together, and often it is not easy to quickly spot the tool wanted at the moment.

It is hardly possible to show a tool stand suitable for all, as the variation of the tools used by different people is so great, but the one here described, and which is so simple to make, has been in use for years and the method of making is applicable to any set of tools.

It consists of a base board ¼ in. thick ; on this is screwed, from the underside, a ¾ in. by ¾ in. batten. On the batten, at one end, two ¼ in. by ⅜ in. parallel strips are screwed to hold upright a small steel square. Along the centre-line of the batten, holes are drilled down as far as the baseboard, of varying sizes, to accommodate the tools scheduled in the list below. Two ⅜ in. by ¾ in. strips are attached by a screw at each end to the sides of the ¾ in. batten, each of these is recessed, as indicated in the sketch, to take those tools which will not fit into a round hole. The recesses should be made fairly deep and lined with soft leather or felt so as to grip the tool nicely, hold it in position, but at the same time allow it to be readily pulled out without upsetting the stand. Two small brackets are fixed at the front to carry a small repousse hammer which is useful for work with the centre punches, etc.

The numbers on the sketch refer to the following list of tools.

1.—Inside calipers.
2.—Outside calipers.
3.—Caliper gauge.
4.—Feelers.
5.—Tweezers.
6.—Small steel square.
7, 8, and 9.—Set of three small turnscrews.
10.—Medium centre punch.
11.—Fine centre punch.
12.—Scriber.
13.—Fine scriber.
14.—Mounted needle point.
15.—Scribing knife.
16.—Dividers.
17.—Drill gauge.
18.—Protractor.
19.—6 in. steel rule.
20.—Repousse hammer.
21.—Small vee blocks.

Perhaps the stand should be made a little longer than the present tools require, as no doubt, additions will be required from time to time, and as the construction is so simple the provision for them can always be made.

TURNING SHORT TAPERS

ALTHOUGH experienced readers will be familiar with the practical side of the subject, there are, no doubt, some newcomers who will find a few notes on taper turning helpful.

In order to form a mounting for a gear wheel or collar, a short taper is often machined on a drive shaft; a common, commercial example of this is the coned seating on the armature shaft of a magneto for the purpose of securing the driving sprocket.

As these tapers are usually only of short length, they are generally machined in the small workshop by the setting over of the lathe topslide to the appropriate angle.

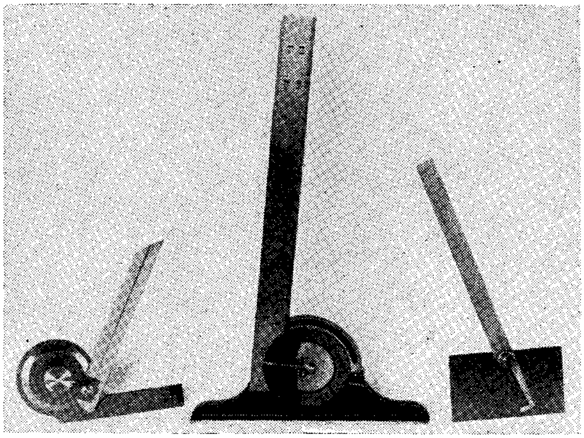


Fig. 1. Three types of protractors in common use

Setting the Lathe Topslide

The angularity of the topslide relative to the lathe axis can be set from the scale engraved on the slide base. But the accuracy of a setting made in this way cannot always be relied on; for, if there is any slackness in the bearing on which the slide rotates, the angularity may vary for any particular reading of the scale. Again, the scale markings may be roughly impressed and difficult to read exactly.

In the precision lathe, on the other hand, the slide is graduated with the accuracy of a high-grade protractor, and the central pivot bearing is closelv fitted. To obtain an accurate

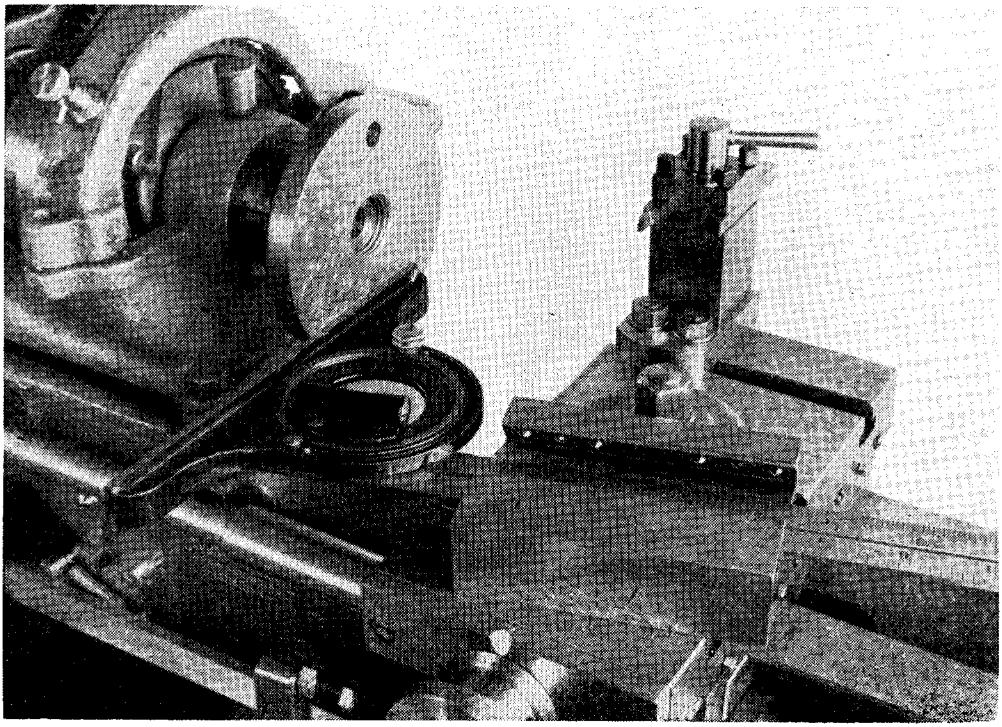


Fig. 2. Setting the topslide with the protractor

setting, a reliable method is to remove the sliding portion of the topslide and to make the angular setting from the guide V of the base casting. For this purpose, the datum face should be the V that is not in contact with the gib-strip ; this face takes the thrust during external turning, and the gib merely maintains the proper adjustment of the slide. When the protractor has been set to read half the included angle required on the work, the blade is held in level contact with the V and rests on the flat surface of the slide base. The base of the protractor is now brought up to the face of the chuck or driver plate, and the slide itself is rotated until accurate contact is made.

It is advisable to check the setting after the slide clamp-nut has been finally tightened.

Three types of machinist's protractors are illustrated in Fig. 1 ; an inexpensive Starrett tool ; a Brown & Sharpe instrument of great accuracy ; and the protractor-head and rule forming part of the Starrett combination-square equipment.

When the slide has been adjusted, it is a good plan to use the protractor, at the same setting, to check the angle formed by the topslide base with the edge of the cross-slide ; for if both limbs of the protractor are found to make even contact with these two surfaces, this method can be used for making future settings and will save the trouble of carrying out the more elaborate routine.

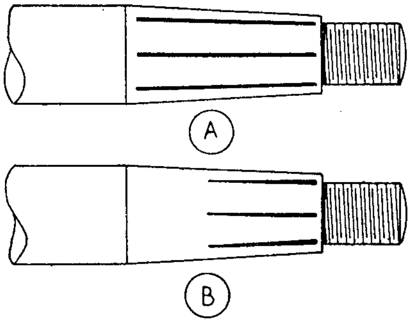


Fig. 3. "A"—the taper marked with witness lines ; "B"—obliteration of the lines indicates areas of contact

Machining the Taper

After the topslide has been adjusted and the work mounted in the lathe, the tailstock centre should, whenever possible, be engaged. For cutting towards the headstock a right-hand knife tool will serve well for the machining, but only a very small flat should be honed at the tip. Needless to say, for doing accurate work the tool must be really sharp and, after grinding, the cutting edge should be finished on an oilstone.

If a true, flat-sided cone is to be formed, it is essential that the tool be set exactly at centre height ; this can usually be done by taking a light facing cut across the end of the work, and the tool is adjusted until it cuts cleanly right up to the centre of the work and without leaving a projecting pip or a central rub mark. The tool is also set with its long axis approximately at right-angles to the line of the taper.

The topslide gib must be carefully adjusted to give free but shakeless movement, for if there is any play in the slide, the pressure exerted when hand-feeding may be enough to upset the accuracy of the machining. The preliminary cuts, to bring the taper nearly to size, may be taken with a coarse feed, but for finishing the work, the lathe is best run at high speed and only a few thousandths of material should be removed by slow and regular feeding. When machining steel, a copious supply of cutting oil should be continuously fed to the work.

Matching Tapers

Where an external taper has to be turned to fit an internal taper, as when making a tapered arbor to fit into the base of a drill chuck, the work is first turned a little oversize to the angle ascertained either by direct measurement or by referring to the chuck-maker's catalogue. The taper is then finished by a process of trial and error. As shown in Fig. 3, lines are drawn along the taper with a soft, lead pencil, and the part is then pressed into its mating taper and given a slight twist before withdrawal. The position of the obliterated pencil lines will at once show where contact is taking place and in what direction readjustment of the topslide is needed. When resetting the slide, the protractor, still clamped

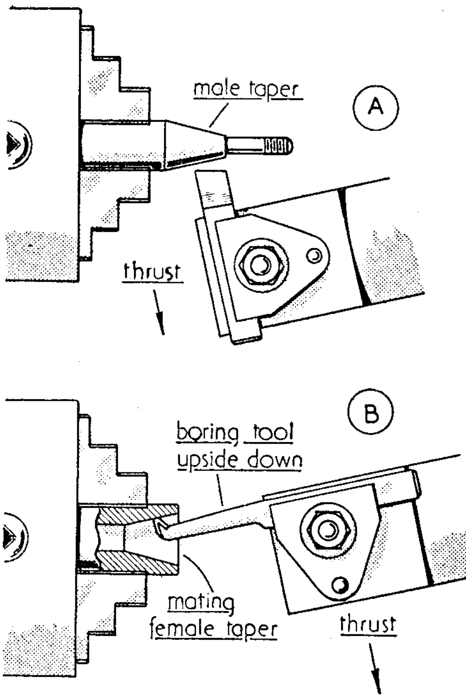
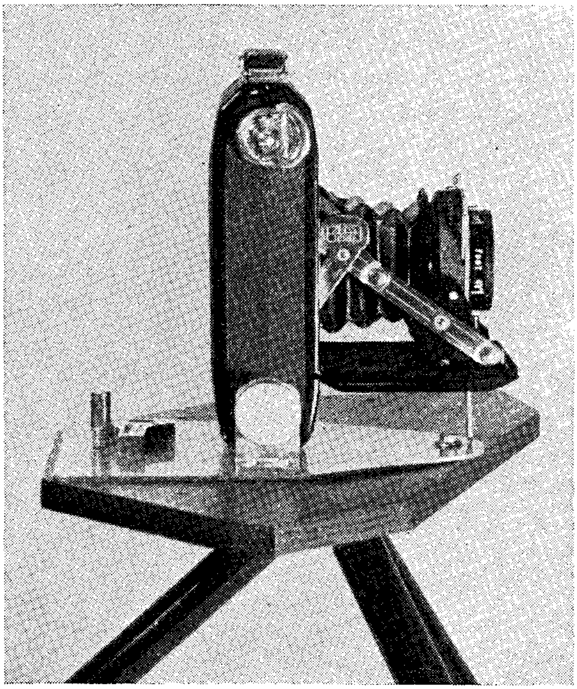


Fig. 4. "A"—turning an external taper ; "B"—machining the corresponding internal taper with the tool reversed

(*Continued on page 486*)

A SIMPLE PANORAMIC HEAD

by George Bowker



"Simple but efficient"

MOST amateur photographers must have at some time or another stood and admired some lovely stretch of landscape or coastal scenery, or perhaps the club track, and said, "If only I could get all that in my camera, what a picture it would make!" Many folk attempt this, by making several exposures, and then join them together, but usually find that some gave far too much overlap, whilst others would not even join up successfully.

The simple apparatus described in these brief notes cuts out the guesswork and makes success assured. It does for your camera what a dividing head does for a lathe.

First of all, ascertain the focal length of the lens in your camera. This is usually stated on the lens mount. Failing this, it is fairly easy to measure the approximate distance between the centre of the lens and the position occupied by the film which is, of course, the focal length.

Most lenses for the popular $2\frac{1}{4}$ in. × $3\frac{1}{4}$ in. camera are about 4 in. and for the 16 on a 120 film the focal length is around 7 c.m. or $2\frac{3}{4}$ in. My own camera is the latter size, and the illustrations show how simple the apparatus is.

The following measurements are suggested for the average $3\frac{1}{4}$ in. × $2\frac{1}{4}$ in. camera with a 4 in. lens, but it will be appreciated that these will have to be modified where the focal length differs.

Describe a semi-circle with a radius of 4 in. on a piece of plywood with the centre about $\frac{1}{2}$ in. from one edge. Mark off round the circumference four sectors equidistant from one another. The distance between the points should equal the width of the picture taken with your camera, less $\frac{3}{8}$ in. so that the distance between each marking will be 2 in. Now draw lines from the centre point to the markings on the circumference.

These sectors will equal in angle to the angle of view of your camera, less $\frac{1}{4}$ in. overlap.

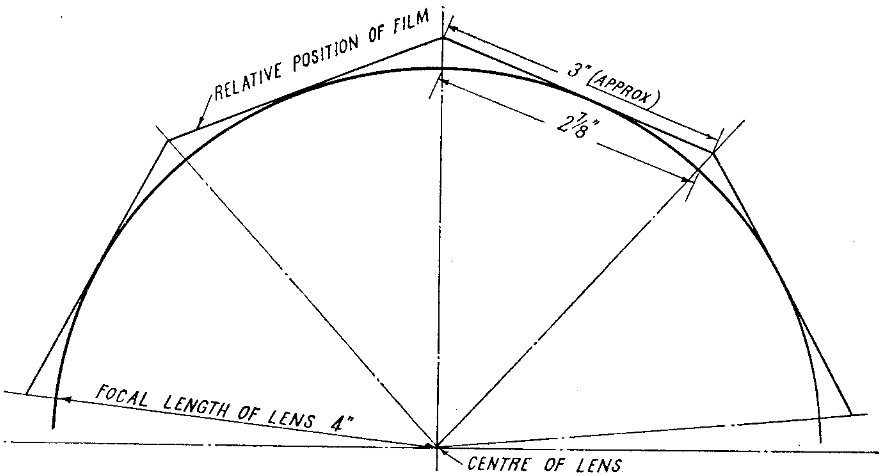
A hole for a 5-B.A. screw should be drilled at the radius point.

A carrier for the camera must be made out of $\frac{1}{16}$ in. sheet metal, and this is secured to the baseboard by the 5-B.A. screw mentioned, but it must be sufficiently free to slide smoothly over the baseboard.

In the centre of the carrier, $\frac{1}{2}$ in. from the rear, a $\frac{1}{8}$ in. hole is drilled. A small engaging pin should be made from $\frac{1}{4}$ in. brass rod, turned down at one end to $\frac{1}{8}$ in. for a distance equal to the thickness of the plywood base, plus the thickness of the carrier plate. Beyond the turned-down portion a few threads ($\frac{1}{4}$ in. Whit.) should be screwed, the reason for which will be explained later.

A centre-line should be drawn down each sector on the baseboard. The carrier plate should be secured to the former by the 5-B.A. screw and nut, and washers. The hole in the rear of the carrier plate should be moved in turn over the centre-line of each sector on the baseboard, and using the hole as a drilling guide, drill each sector. The carrier plate can thus be locked in four positions by means of the engaging pin.

The method of securing the camera to the carrier plate will vary according to the construction of the camera. In my own case it is merely an L-shaped piece of $\frac{3}{4}$ in. × 3/32 in. strip of brass secured by two 8-B.A. screws in tapped holes in the carrier plate. A $\frac{5}{16}$ in. hole is drilled in the upright portion, and a knurled screw ($\frac{1}{4}$ in. Whit.) placed through this hole engages with the tripod bush in the side of the camera. This, together with the supporting strut at the front which forms part of the camera, holds the latter securely in position.



Plan of camera carrier

The overall dimensions of the baseboard and carrier plate matter not a jot. The essential features are that the centre of the lens is over the pivot point, and that the sectors are made in the manner described.

To complete, a 2 in. square of $\frac{1}{16}$ in. brass or steel is secured to the centre of the underside of the baseboard by four countersunk wood screws. To the centre of this plate is silver-soldered a $\frac{1}{4}$ in. Whit. brass nut. This, of course, engages with the tripod screw. Naturally, a tripod must be used when taking panoramic pictures, or alternatively the apparatus must be held securely on some level object.

I fastened a small T-shaped spirit level on my carrier which saves a lot of fiddling about, when trying to get the outfit level.

The reason for screwing part of the engaging pin $\frac{1}{4}$ in. Whit., is that when it is not in use it may be screwed into the tripod nut to prevent loss. For the same reason the knurled screw may be secured to the L-shaped standard when not in use by a $\frac{1}{4}$ in. Whit. nut.

To give the apparatus a finished appearance, the baseboard was painted with Rosco cylinder black, and the metal parts with aluminium paint, which provides a finish similar in appearance to satin chrome.

Turning Short Tapers

(*Continued from page* 484)

at its original setting, can be employed to check the amount the slide is moved.

Internal tapers are machined in the same way ; but when testing the fit, the degree of contact will be more readily estimated if the male taper is lightly smeared with marking paste.

Machining Mating Tapers

When two parts have to be machined with tapers to fit accurately together, the work will, as a rule, be found easier if the internal taper is machined first and the external taper afterwards turned to fit.

It might be thought that, to obtain a perfect fit, it is only necessary to set over the topslide and then machine the two components in turn. Unfortunately, this is not so, for it will be realised that, when turning the internal taper, the tool tends to be pushed in a direction away from the operator, and when machining the external taper, the thrust against the tool is in the opposite direction. The accuracy of the fit obtained will depend on the construction of the lathe, but in all ordinary lathes, the sum of the clearances in the headstock bearings and machine slides will be sufficient to alter slightly the angularity at which the two machining operations are carried out. On the other hand, if the direction of the tool's thrust can be kept the same for cutting both tapers, then any clearances present will have less adverse effect, and a more accurate mating of the parts may be expected. As illustrated in Fig. 4, the external taper is turned with a knife tool in the ordinary way, but for machining the internal taper the small boring tool is mounted upside down. Even then, the accuracy of the internal taper may be upset by springing of the rather slender tool ; so for the final cut, traverse the tool through the work several times without increasing the feed.

More about Oscillating Engines

by H. E. Rendall

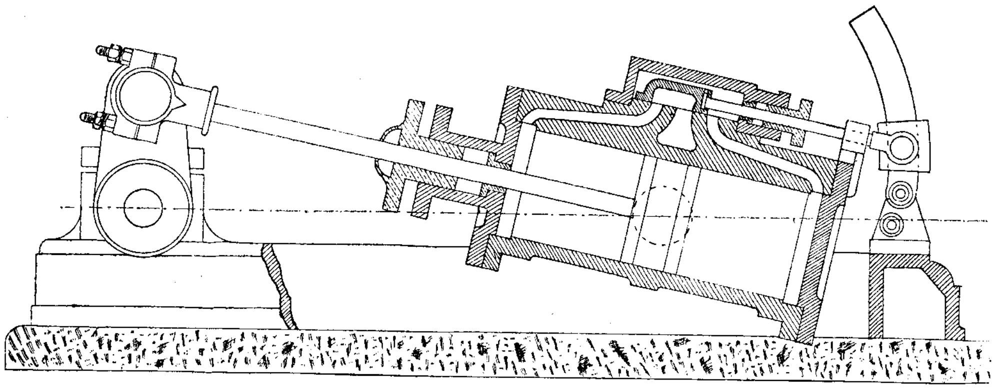


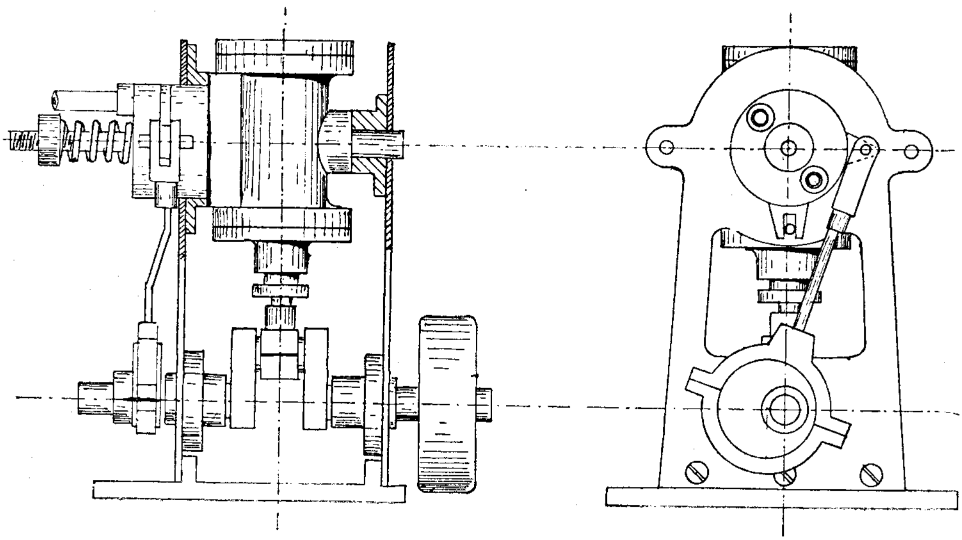
Fig. 1. Section of an oscillating engine fitted with simple valve gear

THOUGH it seems probable now that the oscillating engine will never again be revived, I feel that there still remains some interest in the oscillating principle. Oscillating paddle engines have often enough been illustrated in THE MODEL ENGINEER, but there were also numerous small stationary engines built from the middle of the last century up to its closing days. These early engines had slide valves operated by two types of valve gear :

(1) By means of an eccentric, as in Penn's paddle engines and others. In this case the steam distribution was exactly the same as in a fixed cylinder slide-valve engine.

(2) By the oscillation of the cylinder alone and, therefore, steam was carried for the whole of the working stroke. The slide valve had about $\frac{1}{16}$ in. inside and outside lap to prevent a blow through from steam to exhaust.

As the second type of valve gear is not so well known as Penn's, I give an example of it, copied from some drawings I have of a 4 h.p. horizontal engine. I think its action is pretty clear from the figure and it is rather interesting to note that the makers have considered it worth while to fit a curved arc and have not fallen into the temptation to fit a straight slide for the sake of simplicity. The travel of the slide valve can be adjusted by



Figs. 2 and 3. Design for an improved oscillating engine

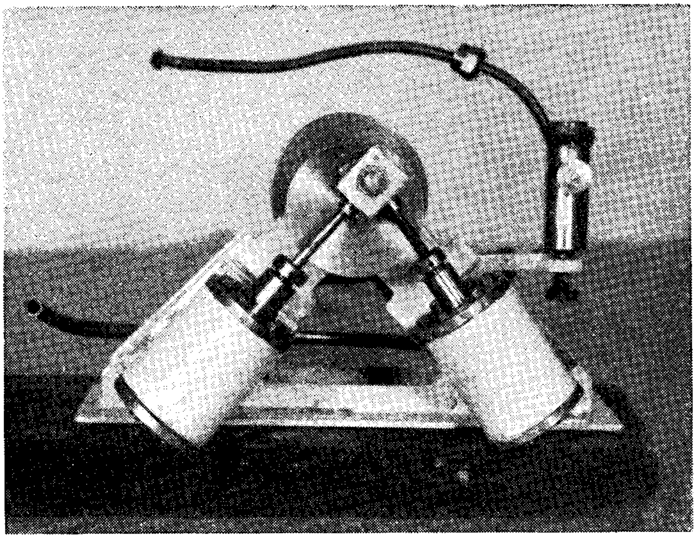


Fig. 4. An oscillating engine for a model paddle steamer

and they also carry the main bearing bushes. The portface of the cylinder also carries a light trunnion-pin to locate the valve block, carrying the steam and exhaust pipes and this has a little slotted lug, engaging with a pin on the framing to prevent the block rotating. The spring, shown, keeps this block up to the cylinder face against the steam pressure, and the kick of the piston is resisted by the side bearings. A little refinement is the insertion of an expansion plate between the portblock and cylinder, rocked by an eccentric, to give and earlier steam cut-off.

Figs. 4 and 5 are photographs showing the construction of a ½ in. bore × ¾ in. stroke oscillator, which I have recently completed for a 4 ft. 6 in. paddle steamer, though I wish now that I had designed it on the lines outlined above, but still it is a nice little engine, and geared down 2 : 1 it drives the 4⅜ in. dia paddle wheels at a satisfactory speed with steam at 25 lb. pressure. The frames are built up of light gauge steel, sawn and filed to shape, while riveted together, exhaust and steam pipe holes being drilled at the same time. The frames at the top are brazed to a flanged steel bush, which is fitted with long brass bushes for the crankshaft bearings. They are also stayed by two steel rods and screwed to angles on the steel base, making a light and rigid

altering the inclination of the arc and where a reverse motion was required, the arc was pivoted centrally and fitted with a lever to tilt it forwards or backwards. A similar valve motion could be obtained by using links in place of the slide. An important feature of all these engines, big or small, was that the cylinders were supported on trunnions each side and there was no more friction in them than in a fixed cylinder engine. This point has been entirely overlooked by designers of small oscillators, who mount the cylinder on one side and rely on a stiff spring to hold the cylinder to the portblock, against the kick of the piston. The excessive friction in this design has always told heavily against the model oscillating engine. This trouble can be mitigated by choosing suitable metals for the cylinder and the portblock ; for example, an old contributor, Mr. Clements-Henry, in an attempt to get 10,000 r.p.m. out of a single-acting oscillator, used a hardened steel portblock, and I am sure he was on the right track. However, the only real cure, it seems to me, is to follow the full-size practice and support the cylinder each side. Figs. 2 and 3 show one way of doing this. The cylinder has a circular valve face on one side and a trunnion-pin on the other. The periphery of the port face and the trunnion-pin are machined concentric. The cylinder is mounted between two light steel frames, which are braced together each side of the cylinder

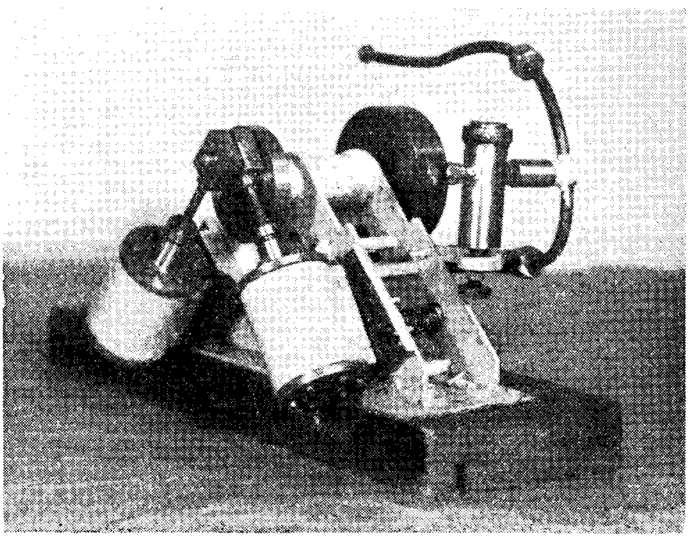


Fig. 5

unit. The cylinders and portblock are machined from gunmetal castings, cast from my patterns by one of our advertisers, Mr. W. K. Waugh. Lubrication is attended to by a displacement lubricator, firmly held by a stay at the bottom as well as by the steam pipe connection. The cylinder trunnion-pins are long enough to project well through the outer framing so that the spring adjusting nuts are easily accessible.

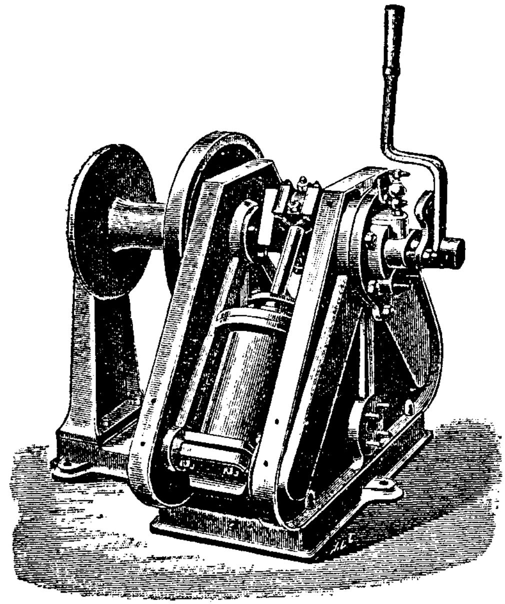


Fig. 6. Higginson & Co.'s ash hoist engine

Mr. H. H. Nicholls in THE MODEL ENGINEER for March 27th, 1952, has given an illustration of an oscillating servo-motor. Compare this diagram with Figs. 6 and 7, which are taken from an illustrated advertisement of Higginson & Co., Liverpool, for 1892. These engines have precisely the same arrangement of ports, and Fig. 6—the ash hoist—has a simple reversing valve to change over steam and exhaust connections.

As well as the ash hoist engine, I thought that readers might be interested in the hydraulic riveting steam pump. The firm give this explanation in their advertisement. "On interrupting the circuit by bringing the machine into operation, the momentum of the flywheel instantaneously and effectually performs all the functions of a massive and costly hydraulic accumulator." I think that these engines must have been the last of the breed on the market, though this type is usually referred to as "pendulous" engines. They have not appeared much in the model world, as they have the disadvantage of a very small port opening.

A few years ago a very ancient friend of the writer's described an oscillating petrol motor that he had seen. It was a two-stroke with one end of the cylinder used as a displacer pump and the other end for the explosion cycle. He described it all in detail but, alas, I thought that great age had betrayed him and that it was all just a dream. In this I was quite wrong, for such an engine, "The Loyal," is described in Wallis-Tayler's book *Motor Cars* (1897). Why Mr. Loyal should have attempted to revive a type of engine that was already obsolete in the steam world passes my comprehension. In the same book Riotte is stated to have constructed a motor bicycle with an oscillating engine, driving the rear wheel direct, weighing 9 lb. only and capable of driving the bicycle at 20 m.p.h. on a good level road.

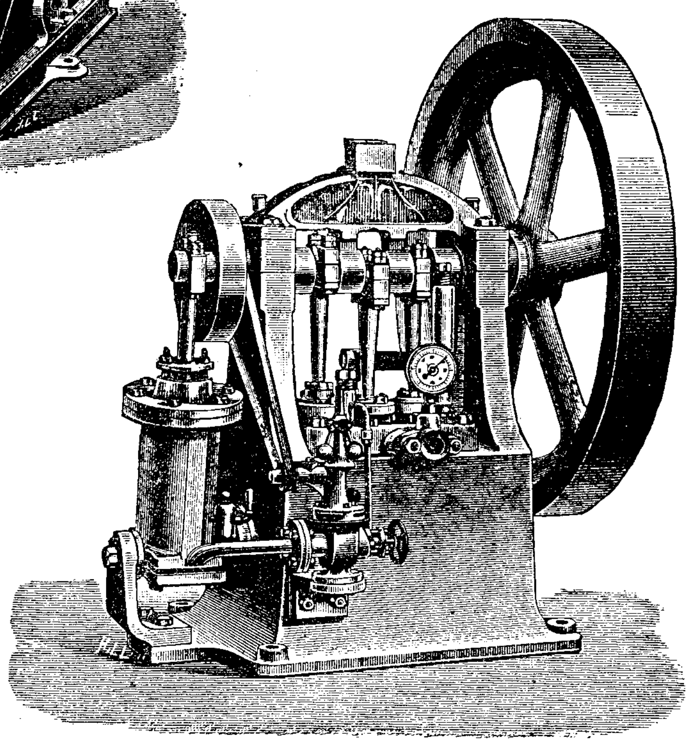


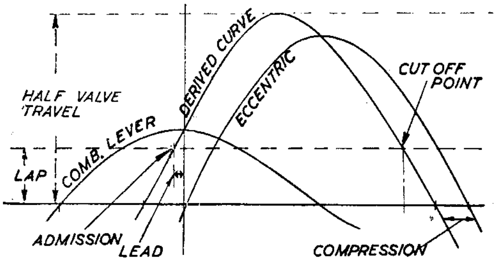
Fig. 7. An hydraulic pump driven by an oscillating engine

The oscillator has done good work with compressed air, hydraulic pressure and, I believe, has figured in hot-air engines.

PRACTICAL LETTERS

Locomotive Valve-timing

DEAR SIR,—With reference to Mr. Keiller's most interesting article on valve events and diagrams, I had some correspondence with him during the early days of the last war concerning the combination of the two sine curves to arrive at the final valve action, and I remember my surprise when he pointed out to me that this derived curve was nothing more than would be obtained with a crank having a larger throw, together with the necessary angle of advance. Obviously all the claims for "quick opening" gears are based on optical delusions.



I wondered why he continued by dropping the sine curve and using the Zeuner diagram to get the various events. All these can be obtained from the sine curve very clearly by drawing a line parallel with the X-axis at a distance equal to the valve lap. The part of the curve projecting beyond this represents the port opening, while the exhaust opens and shuts on the intersection of the curve with the X-axis. I think this is much easier to follow (see sketch).

Yours faithfully,

Gidea Park S.W.C.

Relining and Fitting Leadscrew Nut

DEAR SIR,—I had noticed for quite a time excessive backlash, but having only one lathe I kept putting off the job of recutting a threaded liner, and the reward of my procrastination was a stripped leadscrew nut.

My lathe is an early Drummond with a solid nut, as many other pre-war makes. After a lot of thinking, I decided, as a tempoary measure, to drill and tap a 4 B.A. hole in "nut" and reduce end of a 4 B.A. screw to the width between thread of the leadscrew, in my case $\frac{1}{16}$ in., having adjusted this to protrude approx. $\frac{1}{16}$ in.; and locked it by B.A. nut. This gave me a simple peg drive and answered admirably. I then secured a piece of $\frac{7}{8}$ in. dia. hard brass rod in chuck, drilled and bored it to plus $\frac{1}{2}$ in., cut my thread, turned outer dia. to $\frac{13}{16}$ in. and bush was ready.

My troubles were, however, only half over, as it was essential that the housing in the liner should be bored perfectly concentric with leadscrew. To do this I soldered across the bore of the nut a flat piece of brass, then made a bush to suit leadscrew bearing, with a concentric hole drilled through to fit a length of silver-steel, one end of which is turned down to act as a centre-punch. The leadscrew nut was now replaced in its true working position in the lathe saddle, brought close up to the adapter in leadscrew housing, and centre-popped. The nut was once more removed from the saddle; truly mounted on an angle-plate by using centre dot on strip across bore as register; the strip unsweated, and nut bored to house liner, into which it was afterwards sweated. When assembled, it gave perfect satisfaction, so much so that I have another liner ready in case of further emergency.

Yours faithfully,

King's Lynn. J. D. ELAM.

Old Burrell Engines

DEAR SIR,—I read with interest, Mr. D. Greenwood's letter in THE MODEL ENGINEER, September 11th issue. The showman's tractor he mentions as a "Foster" in a yard at Chichester is a 6 h.p. Burrell, the property of Mr. J. Cole, amusement caterer.

An 8 h.p. scenic Burrell locomotive is also there and this engine appeared in THE MODEL ENGINEER some years ago drawing its train of wagons near the Hogsback.

The "peculiar shaped chimney" that Mr. Greenwood refers to is nothing more than an old domestic copper inverted over the funnels to keep out the weather. This is a favourite chimney cap with showmen. I handled both these engines until the "Oilers" took their places, but I understand from Mr. Cole that he will not scrap either.

Yours faithfully,

Chichester. J. POLDEN